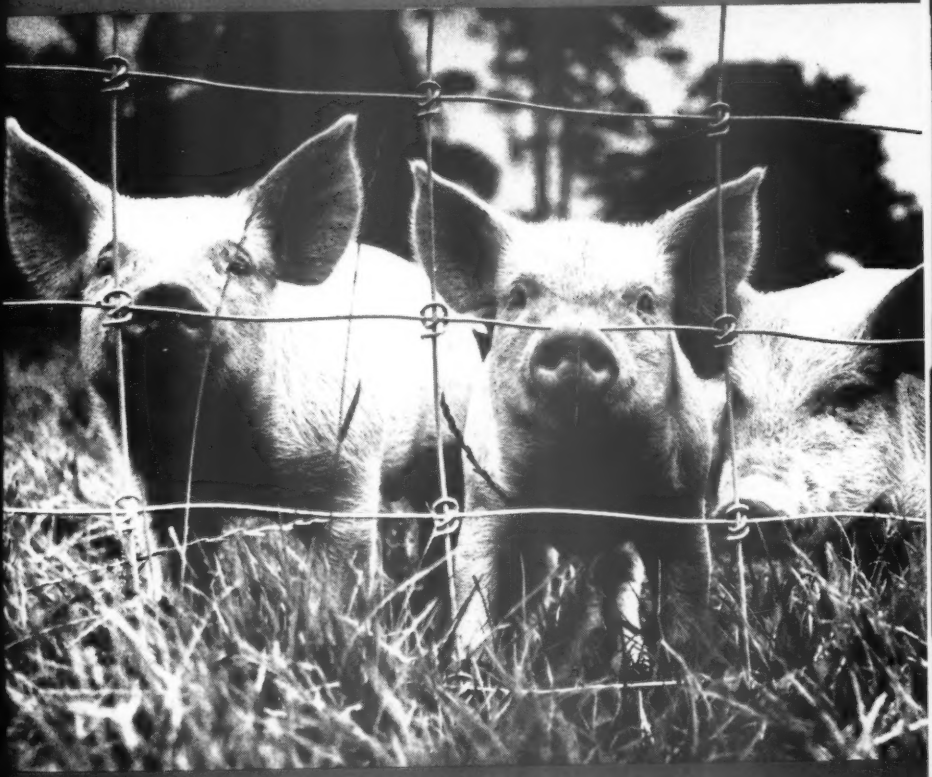
630

September 1956

Agriculture

THE JOHN CREAR LIBRARY
OCT 4 1956

VOL. LXIII No. 6



Great Expectations

Published for the Ministry of Agriculture, Fisheries and Food
by Her Majesty's Stationery Office

NINEPENCE MONTHLY

Jack BARCLAY

LIMITED

The Largest Official Retailers for

ROLLS-ROYCE and BENTLEY

★

BERKELEY SQUARE, LONDON, W.1

Mayfair 7444

MAXUM MINERALS FOR POULTRY BREEDERS The poultry breeder is a vital link in the production of meat and eggs for human consumption. However skilled he may be in brooder design and management, there is nothing he can do inside the egg shell to improve his percentage hatchability. Once the egg has been laid, development of the chick depends on its store of nutrients within the shell. Only good feeding of the laying hen can help to reduce losses up to the emergence of the chick and during the following few days. Minerals — calcium for shell production, and phosphorus, manganese, iron, copper, cobalt and iodine for good chick development — must be present in the food of the hen in adequate, balanced and assimilable form, as they are in **MAXUM POULTRY MINERALS**

See that "MAXUM" MINERALS are in all your feeds (PIGS, POULTRY & CATTLE). Use 2½% with your home-grown food.

Order From Your Local Merchant — ask for price & special leaflet — it will pay you! *If any difficulty, write to:*

COUPER, FRIEND & Co. Ltd.
Head Office: 33/35 EASTCHEAP, LONDON, EC3
Works: LONDON & HULL

BERNARD THORPE & PARTNERS

ESTATE MANAGEMENT

AGRICULTURAL MANAGEMENT DEPARTMENT

HEAD OFFICE:

1, BUCKINGHAM PALACE ROAD WESTMINSTER, LONDON, S.W.1.

Telephone: VICtoria 3012

Branches at 129, Mount Street, Berkeley Square, W.1., York, Newcastle, Edinburgh and Oxted, Surrey

LAND AGENTS & SURVEYORS

Advisers in Farming Efficiency

Bernard Thorpe, F.A.L.P.A. (Past President)

Richard M. Thorpe B.A. (Cantab.) A.R.I.C.S., Q.A.L.A.S., (Chartered Surveyor, Chartered Land Agent)

John S. Lavender, F.R.I.C.S. (Chartered Surveyor)

James K. Scrace B.Sc., F.R.I.C.S., F.A.I., (Chartered Surveyor)

Frank A. Stonehouse, F.A.L.P.A.

covers:

Direct Farm Management of lands in hand

Purchase and Sale of Pedigree and Commercial Livestock

Annual Stocktaking Valuations

Building Construction. Repair, Adaptation and Improvement of existing buildings

Forestry. Care of Woodlands. Timber Valuations

Land Reclamation

Take it easy

WITH THE

MEDWAY 56

Easy to carry and clean to handle, that's Little "Natty" Clean-Sack. It's not often that one small helper can make life so much easier and cleaner for everyone on the farm. But this tough little multi-wall paper sack—the Medway 56—is specially made to carry 56 lb. of feeding stuffs the easier way.* Lighten the work on your farm, insist on feed packed in a Medway 56. Remember half the weight is half the effort.

Remember, feed costs no more packed in paper.

LITTLE "NATTY" CLEAN-SACK says:—

MAKE LIFE EASIER ON *YOUR* FARM WITH

MEDWAY 56 LB MULTI-WALL PAPER SACKS

MEDWAY PAPER SACKS LIMITED · LARKFIELD · Nr MAIDSTONE · KENT · Tel: MAIDSTONE 7242

DIVISION OF THE Reed PAPER GROUP

Get better protection against insect pests with

MALATHION*

* O, O — dimethyl dithiophosphate of diethyl mercaptosuccinate.

Tests in many parts of the world show the superiority of MALATHION over other insecticides in use.

It acts rapidly — is economical to use.
Residues on crops disappear quickly.
It has a wide margin of safety to user.
MALATHION kills flies too, even those resistant to other insecticides.

British-made MALATHION is now available in insecticide preparations from your local supplier.

Use MALATHION to control insects—including flies—for:

FRUIT · VEGETABLES · FIELD CROPS
FLOWERS · ORNAMENTALS · FARM BUILDINGS
ANIMAL HOUSES · RUBBISH TIPS
AROUND WATER TROUGHS.

CYANAMID PRODUCTS LTD.
AGRICULTURAL CHEMICALS DEPARTMENT,
BUSH HOUSE · ALDWYCH · LONDON · W.C.2.

You will need

Fisons 30 Range

CONCENTRATED COMPOUNDS

for your

Autumn Corn

A good start is vital to the success of your Autumn Corn. That is why it is so important to use a compound high in phosphate and potash such as Fisons 35 or 37. You need phosphates and potash to produce that vigorous, strong-rooted plant which comes through the Winter well and leads to a full crop at harvest time.

Apply at these rates

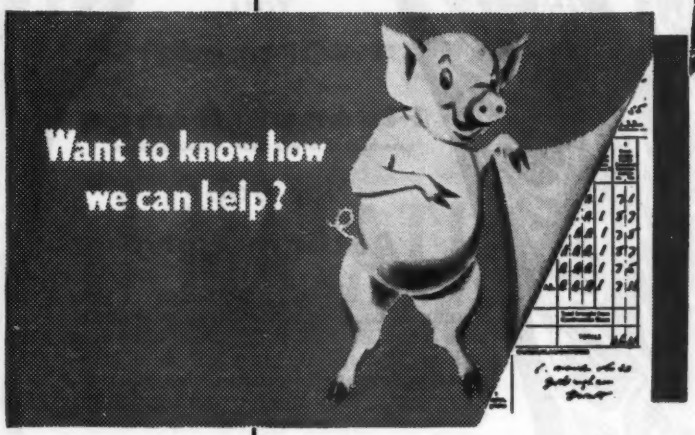
Fertilizer	Soil Conditions	Rate/ Acre	Remarks	
Fisons 37		3-5 cwt.		Top dress with nitrogen in Spring
Fisons 35	Soils low in nitrogen	3-5 cwt.	Especially for all second straw crops	

It's Fisons for good farming

8367-1

New! FUL-O-PEP PIG CONCENTRATE

Mix 1 part with 8 parts home-grown cereals



Here's the practical way to reduce Feeding costs, make the most of Government subsidies for home-grown cereals and get bigger profits through better feeding. New Ful-O-Pep Pig Concentrate. THE MOST MONEY-SAVING PIG FEED EVER! Post the coupon TODAY for the free leaflet with feeding plan. Order Ful-O-Pep Pig Concentrate from your local merchant.

GET EXTRA PROFITS WITH PLANNED FEEDING

FUL-O-PEP

To: Ful-O-Pep Feeds A.G.1(P.C.), Quaker Oats Limited, Southall, Middlesex. Please send me the free leaflet on the new Ful-O-Pep Pig Concentrate.

NAME.....

ADDRESS.....

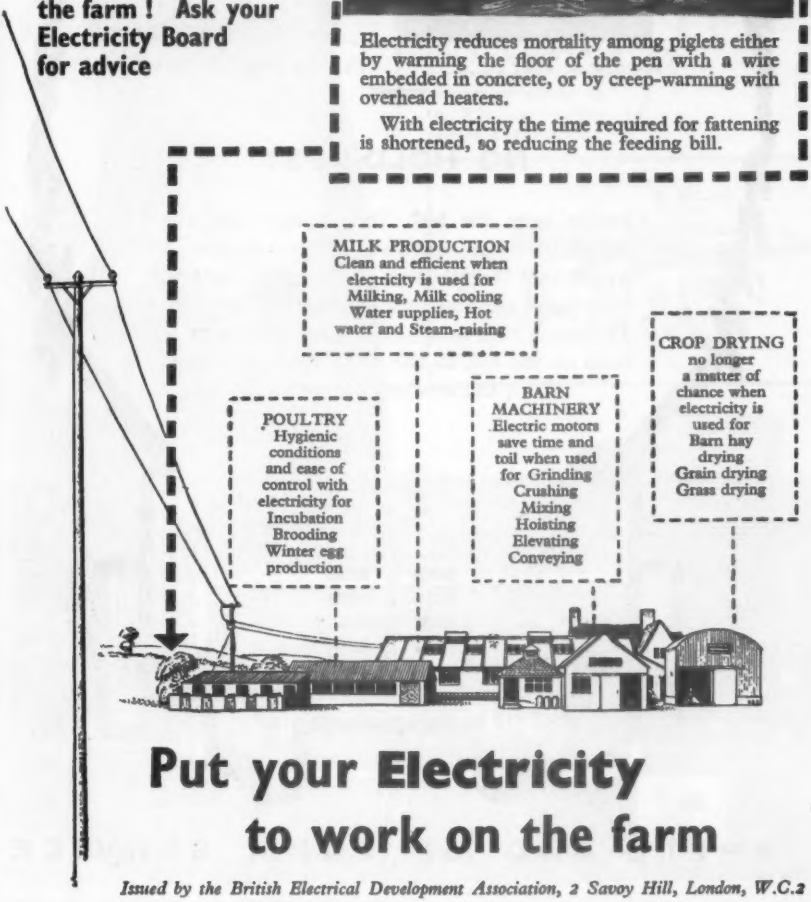
.....

Electricity –don't shut it up in the farmhouse

—put it to work on the farm! Ask your Electricity Board for advice

Electricity reduces mortality among piglets either by warming the floor of the pen with a wire embedded in concrete, or by creep-warming with overhead heaters.

With electricity the time required for fattening is shortened, so reducing the feeding bill.


MILK PRODUCTION
Clean and efficient when electricity is used for Milking, Milk cooling Water supplies, Hot water and Steam-raising
POULTRY
Hygienic conditions and ease of control with electricity for Incubation Brooding Winter egg production
BARN MACHINERY
Electric motors save time and toil when used for Grinding Crushing Mixing Hoisting Elevating Conveying
CROP DRYING
no longer a matter of chance when electricity is used for Barn hay drying Grain drying Grass drying

Put your Electricity to work on the farm

Issued by the British Electrical Development Association, 2 Savoy Hill, London, W.C.2

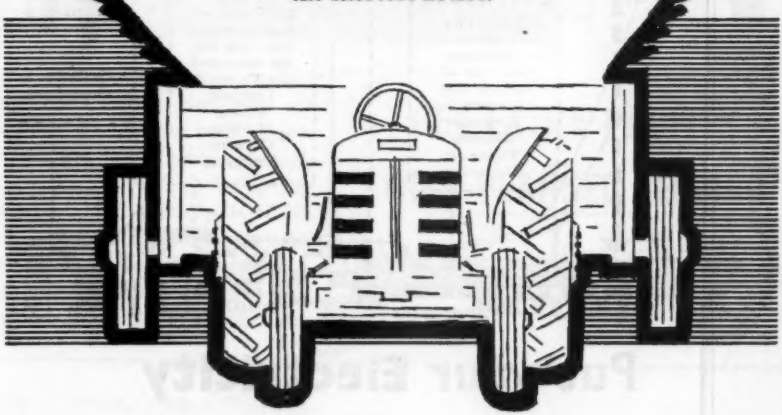
Get more pulling power with these fine tractor fuels

Shellspark | **Diesolite**

Finest v.o. ever . . . . . | *the unbeatable diesel fuel*

NO HOLD-UPS!

Besides being the best, these fuels are the easiest to obtain. Shell and BP have appointed Authorised Distributors all over the country. They know local farming through and through. The one in your area will see that you get your fuels on the dot, in the right quantity and at the shortest notice.



SHELL AND BP FARM SERVICE

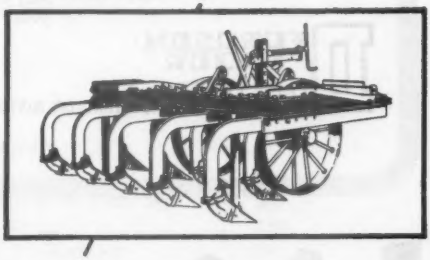
SPANNING THE WORLD OF CULTIVATION

Arabs overlook the desert wastes of Africa and no doubt wonder what is happening to provide a solution to the constant threat of famine.

Ransomes are playing their part in providing implements which can assist in making these barren areas fertile and crop-producing.

Illustrated in the panel below is the C.17 cultivator, suitable for tractors 35-50 drawbar H.P. and for cultivating widths up to 9 ft. In really severe conditions.

WINGS DAY SEPT. 15th GIVE FOR THOSE WHO GAVE



Ransomes

RANSOMES SIMS & JEFFERIES, LTD., IPSWICH, ENGLAND Famous throughout the world for agricultural machinery

Yes, but you can't take risks with Autumn Ploughing

MAKE SURE WITH A **MAJOR**

Proved by nearly 150,000 Major Diesel farmers to give extra power, more economically. Backed by the finest service and spare parts organisation at standardised, money-saving charges. A Dagenham product — made by Ford, sold by Ford — the surest guarantee of best value for money.

Any field, any weather—a demonstration is yours for the asking. Ring your dealer today.

FORDSON MAJOR DIESEL

TRACTOR DIVISION FORD MOTOR COMPANY LTD
DAGENHAM ESSEX

LEADS IN VALUE

AGRICULTURE

Editorial Offices: The Ministry of Agriculture, Fisheries and Food,
3 Whitehall Place, S.W.1 (*Phone: TRAfalgar* 7711)

VOL. LXIII No. 6 SEPTEMBER 1956

¶ *Provided that the source is acknowledged in each instance, such articles and notes as are published in this Journal without any specific reservation regarding copyright may be reproduced in any registered newspaper or public periodical without special permission. The Ministry does not accept responsibility for statements made, or views expressed, in signed contributions to this Journal or in those reproduced from another source.*

¶ *Further, the Ministry does not accept responsibility for any of the private and trade advertisements included in this publication.*

¶ *In the interests of factual reporting, occasional reference in this Journal to trade names and proprietary products may be inevitable. No endorsement of named products is intended, nor is any criticism implied of similar products which are not mentioned.*

¶ *All communications respecting advertising in the Journal should be addressed to the Advertisement Contractors, Cowlishaw and Lawrence (Advertising) Ltd., 14-16 Ludgate Hill, London, E.C.4. Telephone: City 3718.*

Contents

	Page
Design of Pig- and Poultry-Houses. *D. W. B. Sainsbury* ...	255
This was Scrubland. *G. D. Nightingale*	258
Carotene in Preserved Feedingstuffs. *V. H. Booth*	261
Gall Midges as Pests of Farm Crops (1). *H. F. Barnes* ...	265
Indoor Mechanization and the Small Farmer. *R. B. Whaley* ...	268
Virus Diseases of Insects: Their Use in Biological Control. *K. M. Smith*	271
Growing Freesias. *R. L. C. Foottit*	276
Chemical Desiccation of Red Clover for Seed. *S. A. Evans* ...	280
Forestry on the Agricultural Estate. *R. E. Dowse*	283
Estate and Farm Roads in the Old Days. *G. E. Fussell* ...	287
Farming Affairs	292
In Brief	295
Book Reviews	298

Cover Photograph

Great Expectations

Copyright : John Topham

Now, about seed dressing . . .

You buy improved strains of seed, you use modern methods of cultivation — to complete the cycle of progress, insist on DIELDREX 'A' SEED DRESSING, the up-to-date two-way seed dressing which gives cereals an astonishingly high degree of protection against Wireworm and seed-borne disease. Non-tainting. Does not affect germination. Very economical — a few shillings an acre spent on having your seed dressed with DIELDREX 'A' will be repaid over and over again. Ask your Shell Chemical Distributor or local supplier for full details.

Dieldrex 'A' Seed Dressing

Approved by the Ministry of Agriculture, Fisheries and Food.

SHELL

SHELL are the largest organisation in the world engaged in the manufacture and distribution of agricultural chemicals.

SHELL CHEMICAL COMPANY LIMITED, Norman House, 105-109 Strand, London, W.C.2.

AGRICULTURE

VOL. LXIII No. 6 SEPTEMBER 1956

DESIGN OF PIG- AND POULTRY-HOUSES

D. W. B. SAINSBURY, PH.D., B.SC., M.R.C.V.S.
Royal Veterinary College

Dr. Sainsbury discusses some of the common mistakes that are made in the design and construction of modern pig- and poultry-houses and suggests some ways of avoiding or remedying them.

THE need for proper control of the environment in piggeries and large intensive poultry-houses is fairly widely appreciated today. Unfortunately, the excellent potentialities of many modern houses and conversions have often been wasted in practice through inattention to details which at first sight seem trivial but which, in fact, can completely destroy their chances of securing good conditions for the stock. Many of the methods and materials now in use are new to agriculture, and techniques are of necessity often experimental. The purpose of this article is, therefore, to pinpoint some of the more common errors and snags seen by the writer, and which are really a by-product of the far more exacting conditions required nowadays for higher productivity and better health.

Ventilation Bad ventilation, leading to overheating and stuffiness in the summer and to condensation, cold and draughts for the rest of the year, is certainly a root cause of most of the problems that occur. Faults in ventilation can be listed under two headings—the first being concerned with the inlet of fresh air, and the second with the extraction of stale air.

AIR INLETS Commonly, air inlets are too few in number, not sufficiently controllable and badly placed. Whether ventilation is by natural means or by the use of fans, it is essential that the fresh air comes in evenly from all sides of the building so as to prevent the formation of stale pockets of air in which moisture will accumulate and condense.

Various types of baffled wall inlets give satisfactory results. Windows can also be used as inlets, but serious errors are often made in the area and form of window that is used. In fact, of the various designs, only two seem to give good inlet ventilation—the inward opening hopper window for either piggeries or poultry-houses, and the vertical sliding window for poultry-houses. If one is going to rely on the conventional system of window inlets in the walls and the outlet of stale air through ridge or high level extractors, there is every chance that the arrangement will be satisfactory. It is essential, however, that the roof or ceiling, and any duct carrying the stale air, should be properly insulated and that the areas of the ventilators should be correct. Too often one or more of these requirements is not satisfied, and the opening window area is far too small. Where windows are to be relied upon as the only inlets, a good rule is to have windows of good depth opening along not

less than a third of the wall's length—if more, so much the better. In some buildings, windows can be opened along almost the whole length of the side wall and this can greatly ease ventilation difficulties, though heat will be lost through single glazing. Obviously, less window area is necessary where supplementary inlets in the form of "Tobin-tubes" and other types of baffled inlet are fitted between the windows. Windows which can only be either fully opened or fully closed, with no intermediate control, are not sufficient.

AIR OUTLETS Whereas the inlet ventilation should be as diffuse as possible, "natural" outlet ventilation should be concentrated at one or two points, generally at the topmost part of the building. How different this is from what is usually found in practice! Often, the outlet of stale air is by means of a fixed open ridge, which is totally uncontrollable and acts as an air inlet as well, so causing down-draughts. In other houses, many small ventilator cowls of unnecessary intricacy are placed on the roof, when one or two large vents would be much more efficient. Moreover, metal cowls favour condensation on their inner surface in the winter months and can ruin the condition of the litter in deep litter or broiler houses.

It is generally no longer possible to base a ventilation system on traditional and conventional design, since the concentration of stock in modern houses is far greater than anything envisaged previously. For every new house or conversion, ventilator areas should be worked out beforehand, taking into consideration the situation of the house, the temperature and humidity conditions required, the construction of the building, and the density of the stock. Many troubles arise from basing ventilator areas on the type of house and an arbitrarily fixed number of eight air changes per hour, without reference to the stock kept in it. This is quite unsound; in practice a far greater range than this is required. By means of simple calculations, it is possible to plan a ventilation system which will rid the atmosphere of impurities and yet keep the temperature at a satisfactory level. But it must be remembered that no natural ventilation system is likely to be satisfactory in the absence of properly insulated surfaces, since efficient air circulation cannot then take place.

Mechanical Ventilation Ventilation by electric fans greatly reduces the labour needed to obtain good conditions, and is justifiably gaining in popularity. Sometimes, automatic temperature and, even, humidity controls are fitted. Unfortunately, however, fan ventilation is often used in a wasteful and light-hearted manner, and an odd fan or two tucked away in the corner of a building is expected to cure all the troubles of a badly constructed house. Whether the fans are used to extract the air, draw the air in, or both, the system, which is generally based on a combination of natural and fan ventilation, must be worked out logically beforehand. But more than half the extractor fan systems seen in animal buildings merely result in "short-circuiting" of the air flow, the fans being placed so that they draw most of the air in from nearby doors or windows and then direct it straight out into the open again—without ventilating the house itself.

Thermal Insulation In general, there are no basic faults to report in connection with the insulation of walls and floors. The usual methods using either cavity construction or special lightweight materials, in brick, concrete, wood and so on, work out satisfactorily. Difficulties do occur from condensation on lightly insulated walls over which the air is not flowing properly. However, insulation of the roof causes most of the problems. The real trouble is usually that the outer cladding of the roof, generally of asbestos or galvanized iron, is *impervious* to water vapour.

Under this uninsulated layer there is either a lining, or a flat ceiling, of an insulation material which is *pervious* to water vapour. The damp air from the piggery, therefore, passes through this material, some condenses within it, and the rest reaches the outer cladding and condenses further on its cold inner surface. This drips back on to the insulating material, causing it to deteriorate and thus decreasing its insulation value and building-up dampness in the piggery.

There are two methods of preventing this. The first and most important step is to see that the insulation lining is impervious to water vapour on its under surface, so that the dampness cannot reach inside. This can be done in a number of ways: some insulation boardings are suitably finished to prevent it, others need treating with a paint to seal them to water vapour. If a loose fill insulation like straw or glass wool is used, it should be vapour-sealed with an impervious lining such as roofing felt or kraft paper—or it may be laid on flat sheets of asbestos.

The second method, which is particularly applicable to flat ceilings, is to ventilate the area between the inner and outer roof lining so that damp air entering it can pass right out of the building.

Some other Considerations Attention is rarely given to the position of the pig- or poultry-house in relation to other buildings, and the consequent effect on the efficiency of ventilation. Nearness to other houses can often cause down-draughts, inefficient and uneven inflow of air, and other defects. Various measures can be taken to overcome these difficulties, such as raising the height of an extractor ventilator for removal of stale air, or installing electric fans. It should never be impossible to overcome difficulties of this sort.

Condensation has already been dealt with, but, to sum up, it can be said that it may be caused by any or all of the following: poor ventilation, uneven air circulation, cold surfaces, inefficient thermal insulation, the use of unsuitable materials, and, in piggeries, the use of excessive quantities of water for "cleaning" and bad drainage for its removal.

Pigsties with Outside Yards Piggeries with outside yards, often partly covered, are fairly popular nowadays, but a frequent snag, particularly where there is a large range of these sties, is that draughts tend to blow in too freely through the doorways between pens and runs. As a result, they can easily become cold and draughty, and steps must be taken to remedy this. Firstly, it must be noted that it is a mistake for these piggeries to be double-sided, for winds will blow right through them: the best yards face only in a southerly direction. It is a further advantage if each pen, or pair of pens, is completely separate from the pens on either side (as in the McGuckian house of this type). An efficient baffle wall is advisable between pen and run or, alternatively, some form of swing door. Much excellent advice on this problem has been given by Mr. D. S. Soutar of the North of Scotland College of Agriculture, and his advice here is that "honeycomb" walls should be used in the partition between the yards where baffle walls adjoin, so that the wind can blow through instead of being "funnelled" into the pen. Soutar also advises the use of at least one step up from the yard to the pen, and a minimum 4-inch kerb.

THIS WAS SCRUBLAND

G. D. NIGHTINGALE, F.R.I.C.S.
Agricultural Land Service, South-Eastern Province

A determined onslaught by a Sussex farmer on an area of nearly 300 acres of derelict scrub has already yielded well over 100 acres of good land at a total cost of about £36 10s. per acre reclaimed.

ON the Sussex Downs, a few miles from Brighton, there is a farm of 900 acres. About 65 years ago, a map might have shown much of the land under arable cultivation; but between 1900 and 1940, gorse and thorn had begun to take charge and, by 1946, when most of the South Downs had been enclosed as a battle training area, nearly a third of the holding had for all practical purposes reverted to impenetrable blackthorn and brambles. There were some beech, oak and ash, and dense gorse where the soil was thin; but only a few patches of turf remained, none of them more than an acre in size. Yet, under a tenancy which began only a few years ago, most of this scrubland has already been reclaimed to play its part in the economy of this mixed farm.

One of the first areas to be tackled was that known locally as "Forty Acre". After the initial clearance and deep ploughing, a pioneer crop of kale had been sown in 1953 and the dairy herd had grazed it to consolidate the ground. In 1954, a crop of barley, which had yielded 15 sacks per acre, had been undersown with ryegrass and trefoil for the cows and, by April 10, 1955, twenty-five days' grazing was available for 60 cows on 20 acres. This produced an average of 161 gallons of milk a day without any other food, excepting a small quantity of brewers' grain fed in the milking parlour. For the cereal crop, 3 cwt of complete fertilizer had been applied per acre, after the lime deficiency of 2 tons per acre had been corrected. Last year, top dressing had been fairly heavy, and the ley was given another normal dressing of complete fertilizer this spring, even though cereals were again intended.

I had viewed Forty Acre with the occupier, Mr. Cummins, in early 1955, when our main thoughts were of the transformation. The gorse, blackthorn and brambles had gone, giving way to normal farmland. Clumps of beech around pylons, and in places where they could help to provide shelter, had been carefully selected and preserved. The job of flint-picking alone remained—a task so difficult to assess as to cost. But by the spring of this year, we were able to discuss the known costs of reclamation of the land at a point where cultivations and fertilizer usage were getting down to average. We did so, not only to discover if the net cost to Mr. Cummins had yet been recovered in full, plus a small return on the considerable capital he had put into it, but also to provide me with evidence that a block of land to the north (the rectangle mentioned later) would, if similar in contours and growth, be eligible for grant.

A Forbidding Problem At the end of Forty Acre, to the east and south of it, lies another 75 acres of reclaimed land in the form of a triangle, the apex of which is within 200 yards of the farm buildings. To the west of the farmhouse, almost the whole of the quarter-circle in view, except for the Forty Acre, is now permanent pasture or long leys, including vital lay-back for the dairy herd. To the east, over a wooded ridge, is most of the corn land. But north of that there remains a wide rectangle of scrubland, still to be tackled, still carrying some rabbits; the "dead" area of the farm.

THIS WAS SCRUBLAND

What a forbidding problem this Triangle had seemed last year. There were some oaks between 75 and 80 years old. Gradients were difficult to estimate, and the costs which lay ahead were largely based on a guess as to what saving could be made from £50 per acre over the whole acreage. It was not merely a useless block to farm around and beyond—it was a liability.

Yet the task of reclamation was so obviously worth while. A survey and frequent soil tests showed that, in general, there were 12-15 inches of soil, though in some open places there was little more than 3 inches. Nowhere was there a slope so steep as to make it unsafe for a combine harvester.

Mr. Cummins put the work in hand and, by this spring, could look at the Triangle with very different thoughts. Clearing was nearly finished, the rabbits had disappeared (thanks largely to myxomatosis), deep ploughing was well under way, and most of the land could be sown to barley.

The Cost Comparing the accounts for the Forty Acre with those available for the Triangle, it seems clear that costs had risen only slightly as the work progressed towards the denser growth and steeper slopes. Bulldozing had, at first, cost £10 per acre, ignoring wear and tear on the equipment. The negligible increase in cost as the work toughened was no doubt due to improved methods, and, to some extent, to more suitable equipment, as experience was gained. Cutting up and burning never dropped below £15 an acre and had cost as much as £20 until the right technique was found. A prairie buster plough drawn by a tracked tractor had done the deep ploughing, but maintenance had been a heavy expense. The total cost, up to and including the application of carbonate of lime, was about £36 10*s.* an acre. Cattle fencing with three rows of barbed wire cost a further £75 a mile.

Both Mr. Cummins and I were satisfied that there was enough data available to assess the working costs of the next block of the "dead" area, after a careful survey had been made.

Following our tour of Forty Acre and the Triangle, we then paid a visit to the valley, where clearance was still going on. There the machine was working on a considerable slope, the driver bulldozing and stoking up his fire alternately. The land he had cleared had no holes or gulleys which would embarrass the ploughman, but the blackberry runners were enjoying the lack of competition from top growth.

Tree Removal The method of attacking an awkward, three-prong silver birch that had been there since the turn of the century was interesting, and perhaps worth describing in detail. First the driver put the saw tooth edge of the bulldozer blade to one prong at about six feet above the ground and shoved until the front wheels lifted. Then he went back and took about two inches of earth and all the roots he could cut, the tractor pushing until the half-tracks ceased to grip. Another shove high up in the prong exposed a few more roots, and these he cut in a second operation. A third high thrust pushed the birch right over, the tree lying across the slope with the top growth nearly touching the ground on the side away from the machine, so that any bulldozing from that direction was useless. Still working on the contour, he cut the roots on the upturned stool in little bites, working downwards to sever the roots and at the same time drop the soil back into the hole from which it came. Then he cut the roots on the lower side as low as possible without digging a hole with his blade. That done, he moved to the higher side and, putting the saw tooth edge of the bulldozer blade to the top of the stool, rotated it about half a turn downhill. Having made sure he had cut all the roots he could get at, he returned to the contour approach

and, on the second or third thrust, pushed the stool clear. Surprisingly enough, the whole operation had taken less than four minutes.

Two lessons stand out clearly from this operation—the use of leverage and the cutting of roots. The result was a stool with no more than a barrow or two of earth left on it and a tree which could be pushed 15 yards or so to the fire. An oak up to 18 inches in diameter took rarely more than five minutes to get out, and, after cutting a length for a fencing post, the rest was burnt in the nearby fire.

Practical Advice Impressed by the transformation that had taken place in such a short time, I asked Mr. Cummins for some hints to pass on to others who might be faced with similar problems. For, as all concerned with this reclamation soon discover, a little experience can save a tremendous amount of time and money. Briefly, his recommendations were:

1. Have all the other work on the farm up to date before you start reclamation, and keep it so.
2. Make sure the tool is heavy enough for the job.
3. Watch neighbours at their reclamation and copy their best efforts.
4. Remember the halfway mark is reached when all the growth is out of the ground.
5. Avoid large piles of debris. Windrows along the contour and a chain away from all hedgerows is the best method. Never bulldoze downhill, towards the sides of the field or to the hedgerows..
6. Blast out big tree stools and burn the debris.
7. Burn rubbish as the work proceeds, keeping enough light brushwood and waste oil to start the next fire.
8. Keep the land in tillage until all the blackberries, gorse and bramble are eradicated.
9. Expect abnormally high cultivation and fertilizer costs for three or four seasons.
10. Start early on the paper work of getting long-term improvement consent, felling licences, grants, etc.

As I left the farm, I had a last look back at the Triangle and the reclaimed land beyond. In the first half of this century, the scrub had encroached to within 200 yards of the buildings; but, soon, upwards of 100 acres which had grown practically nothing for all that time would be in alternate husbandry. I cannot estimate what the increase in the labour force may be, but I am fairly sure little or no extra machinery will be required to farm this land. The soil is good, it is handy to the farmstead, and it is valley land. On the stock side, I expect an increase of some 50 units.

CAROTENE IN PRESERVED FEEDINGSTUFFS

V. H. Booth,* B.A., Ph.D.

Dunn Nutritional Laboratory, University of Cambridge and Medical Research Council

Carotene, the substance from which all vitamin A is ultimately derived, is usually well supplied in the summer diets of cows at grass and poultry on range, but it is also essential that the winter ration should contain sufficient for the animals' needs.

CAROTENOIDS form a group of intensely yellow pigments. Some of them have vitamin-A activity, and the carotenoid with the greatest activity is known as beta-carotene. The latter is widely distributed in nature and a reference to " carotene " usually implies beta-carotene.

Vitamin A occurs in two forms, namely, as a carotenoid, including carotene found in plants and some animals, and as a colourless substance found only in animals. The second form, well known in fish liver oils, milk, and eggs, is made by animals from carotenoids. Ultimately, all vitamin A is derived from carotene or closely related substances. The practical value of carotene, therefore, lies in its vitamin-A activity, since this vitamin is essential for farm animals. Because vitamin A can be stored in the animal body, an animal that has been kept during the summer on a diet rich in carotene may survive the winter, even if its feed during the winter months has contained none. But lactating cows and laying hens excrete vitamin A in milk and eggs, and they cannot do so for long without depleting their store of it. These animals, therefore, may need carotene, or another form of vitamin A, in winter too. (Hens or pigs not on free range need it always.) The stock farmer who cannot provide winter grazing for all his animals is faced, therefore, with the problem of ensuring that his winter keep for hens and cows contains the vitamin.

Sources of Carotene Carotene is the principal pigment in carrots, apricots, the petals of certain flowers, and in other parts of plants. Related carotenoids, and small amounts of carotene, form the colouring matter in lobster shells, legs of poultry, egg-yolk, butter, maize seeds, autumn leaves, orange peel, tomatoes, other fruits and flowers. Green leaves contain carotene; in fact, chlorophyll is not found in plants without carotene, although carotene is found without chlorophyll. There is a relation between chlorophyll and carotene contents; deep green leaves, for example have more carotene than pale leaves. There is little or no carotene in cereals other than maize, in straw, potatoes, roots other than carrots, in cabbage hearts, or in any near-white materials.

Destructive Systems Carotene is fairly unstable in air. It is destroyed in dead or dying plants by at least three types of chemical system. First, in green leaves there is a mechanism (presumed to be enzymic because it can be " killed " by heat) under whose influence carotene is soon oxidized when the leaves are damaged. For example, if leafy grass is pounded to a pulp, a quarter of its carotene may be lost in ten minutes. No doubt the carotene and the enzyme together have an essential function in the living plant, and the destruction of the carotene is one of the results of the disorganization of plant-cell activity.

* Member of the scientific staff of the Agricultural Research Council.

Second, carotene is lost fairly quickly, as a result of photochemical oxidation, from dead or dying plant material exposed to sunlight.

Third, carotene is slowly lost from dry plant material kept in the dark. This process must be independent of such biochemical factors as enzymes, because pure carotene extracted from plants is also destroyed in this way. Indeed, carotene in crystalline form is lost more quickly than carotene in dried green crops, because the latter contain "antioxidants" that to some extent protect the carotene. Carrots contain but little antioxidant; consequently dried carrots are bleached in a few weeks. A feature common to each of the three systems is oxidation: carotene is stable in the absence of oxygen.

Growing grass has a carotene content of around 90 p.p.m. (parts per million), or about 3 oz per ton, and is therefore a good source of vitamin A. The carotene content of grass leaves nearly equals that of carrots, although the carotene cannot be seen because its colour is masked by chlorophyll. Grass, which covers so large an area of Britain, is a principal source of carotene. The commonest way of preserving grass for winter feed is to make hay. But hay, made traditionally, contains little carotene, for the following reasons. First, the grass is past its prime when mown: the proportion of leaf to stem is low, and stems contain little carotene. Second, as cut grass wilts, carotene is lost by the enzymic process. The slower the rate of drying the greater the loss. Third, although sunshine hastens drying, it destroys carotene photochemically. And fourth, whatever carotene is left is slowly destroyed during storage.

Occasionally (the cynic will say almost never) climatic conditions may favour the retention of carotene during haymaking. A dry wind without sunshine will provide these conditions. Good quality hay may be made, unless the weather is unfavourable, by mowing the grass before it goes to seed and placing it on tetrapods, hut racks, or some other arrangement, for quick drying.

Carotene in Dried Crops For good retention of carotene, forage crops must be dried rapidly and out of direct sunlight; that is, they must be dried artificially. In artificial drying, the water is usually evaporated with the help of hot furnace gases. If a leafy grass with a carotene content of 90 p.p.m. and a dry matter content of 15 per cent is dried, theoretically the carotene content of the product could be $90 \times \frac{100}{15} = 600$ p.p.m. In fact, a product with so high a carotene value is rarely produced, for several reasons. First, even a well-husbanded crop contains a proportion of stems, dead leaves and soil, so that the initial value may be lower than 90 p.p.m. Second, however carefully the crop is treated, some carotene is inevitably lost before and during drying. Third, the dried product, unless scorched and therefore damaged, still contains moisture, which means that an adjustment has to be made to the calculation. A good quality, commercially-dried green crop may have a carotene content of about 200-300 p.p.m., although higher values are sometimes found. Lower values may be satisfactory, depending on the purpose for which the crop is required.

Preservation During Storage Dried green crops may be baled, or milled and packed in paper sacks. During storage of the crop in either form, the carotene is slowly oxidized, and up to half of it may be lost in 6 or 8 months. The meal is hot as it comes from the mill and, since meal is an excellent insulator, it remains hot for months when stacked. Similarly, the unmilled dried crop, if baled hot, will remain hot.

Most chemical activities, including the oxidation of carotene, proceed at rates that increase with rise in temperature. Therefore, if a dried green crop were cooled before storage, the loss of carotene would be reduced. In refrigerated storage, the loss is negligible; but refrigeration is expensive, and its general use must await the development of the simplified refrigerator that has already been proposed.

An almost completely dry meal—having, say, 3 per cent moisture—loses carotene much faster than a meal with 8 or 10 per cent moisture. Therefore, drying should be stopped earlier than is usual at present. In practice, this is not as simple as it sounds, but the difficulties could almost certainly be overcome. By combining moisture control with cooling, the loss of carotene could be reduced to about 10 per cent during a normal storage period. The loss of carotene can be prevented by storing the material out of contact with air. This is one of the most effective and also one of the more expensive schemes for preserving carotene.

Heat is a major cause of carotene loss from stored meal. The origin of the heat is not always appreciated. Although some of the heat is a result of the drying process, much of it is generated during grinding. The meal is milled finely to make it look even, and the grist is heated perhaps unnecessarily. Since meal is bought for its carotene and/or protein content, its appearance is not nutritionally important. If consumers would accept a more coarsely ground material with a higher moisture content, both the loss of carotene during storage and trouble from dust would be reduced.

Dried green crop is used as a major component in the feed of cows on some farms, and as a vitamin supplement for pigs and poultry. These two uses are distinct. The crop is used by cattle primarily for its protein and carbohydrate. The carotene content is unimportant if the green crop forms a high proportion of the feed, because even if nine-tenths is lost, there remains enough in total, and the material may still be superior to hay.

About 5 per cent of dried green crop meal is incorporated into some poultry and pig mashes. Since it is added for its carotene, the meal used must be one from which there has been no substantial loss of carotene. To maintain the carotene value of the mash by adding a higher proportion of an inferior meal is not advisable, because too much fibre might then be included.

Dried green crop meal has certain disadvantages, and opinion is divided on whether or not it is preferable to synthetic vitamin A. Carotene continues to be oxidized in the meal after it has been introduced into a feed compound. On the other hand, the synthetic product can be " stabilized " against loss, although there is some evidence that the stabilizing agent interferes with absorption or digestion of the vitamin. The meal is dusty and is disliked by workers in compounding mills. The dustiness can be reduced, although not completely eliminated, by treating the meal with oil, and an antioxidant can be incorporated to retard the rate of loss of carotene. The synthetic vitamin is not dusty, and is easily added to compound feeds. The question of relative cost is controversial, and some rather doubtful arithmetic has been used to " prove " that the synthetic vitamin preparation is the cheaper. The cost of fortifying with the latter is only a few shillings per ton of mash, but this cost is additive because the weight of the vitamin is negligible. The meal supplies a greater weight, relative to its cost, than do other major ingredients of mash, and it could be argued that fortifying a mash with carotene in this form adds nothing to the cost. But it must be remembered that a part of the meal is indigestible fibre. Possibly the most important argument for died greencrop meal is that it contains useful ingredients other than carotene, including, perhaps, some vitamins not yet " discovered ". The meal also supplies carotenols or " xanthophylls " that give egg yolks an attractive

colour. The orange colour in the yolk suggests that the hen has consumed green leaf material and hence that the yolk contains vitamin A. On the other hand, uncoloured yolks may contain vitamin A if the hen has consumed cod liver oil or the synthetic vitamin (which is colourless). In other words, colour offers a visible test of quality, but it is possible to have quality without colour.

Most of these arguments apply to pig mash as well as to poultry mash, especially that about additional nutrients. Indeed, in one country the pig farmers refuse a mash unless it is green. In Britain, some pig farmers refuse a mash if it *is* green.

Forage crops of many kinds can be made into silage. The extent to which carotene persists in silage varies considerably. Generally the carotene is moderately well preserved, and lactating animals thrive on silage.

Carrots from a clamp have as good a colour as they had when the clamp was made. Evidently carotene is preserved while the roots are alive, although it soon disappears from dried—and therefore dead—roots. Indeed, after carrots have been shorn of their leaves, a related yellow pigment, and possibly the carotene, increases during storage. Maize also retains its colour for a long time during storage. Perhaps the carotenoids in living carrots and maize are protected by metabolic processes. The carotenoids of maize in a poultry food contribute some vitamin A, but not enough for a laying hen. Carrots are a good source of carotene but they are not usually considered to be an economic food for farm animals.

The Function of Carotene It might almost be said that life depends upon carotene, for this widespread pigment probably has an essential function in photosynthesis and is therefore needed by plants. Similarly, the higher animals require ready-made carotene or substances derived from it. Much is known about the chemistry of carotene, its distribution in nature, and the amount needed by farm animals. Yet very little is known about the way it works. There are at least four theories on the function of carotene in leaves, but none is proved, nor is the detailed mechanism of any of them understood. It is known that derivatives of carotene play parts in vision, yet science has but little knowledge of how vitamin A acts in parts of the body other than the eye. What is certain is that animals cannot live without the vitamin.

Further information can be found in the booklet *Preservation of Carotene in Dried Green Crops*, 1955, published by The Association of Green Crop Driers, Cereal House, Mark Lane, London E.C.3.

GALL MIDGES AS PESTS OF FARM CROPS (1)

H. F. BARNES, M.A., PH.D.

Rothamsted Experimental Station, Harpenden, Herts

Despite their smallness, gall midges can cause a good deal of damage to nearly every farm crop. Good farming practice will usually keep the populations down to low levels, but extra precautions, such as spraying, may be necessary in peak years.

SOME of the many insects that come into houses throughout the spring and summer months in the evenings, attracted by light, belong to the family of flies known as gall midges. They are minute, not often more than $\frac{1}{10}$ inch in size, delicate in structure with relatively long legs and feelers and often with bright yellow or red bodies. If one examines them with a hand lens, it will be seen that there are comparatively few long- and practically no cross-veins on their wings. They are short-lived, only surviving a day or two. At this stage they do not feed. On the other hand, their grubs or larvae do and are decidedly injurious, feeding on the sap of plants, thus preventing normal plant growth. Some live on stems or leaves, while others prevent blossoming or seed production.

Unfortunately, there are hundreds of different kinds, each restricted to some extent in the variety of plants it will attack. The result is that, with the notable exceptions of sugar beet and potatoes, almost every farm crop and weed has its own particular kind of gall midge.

Some of those living on weeds are just as important as those living on crops because, in years when the crops are comparatively free from midges, dangerous populations may be building up on the weeds.

Good farming practice always tends to keep the populations down to unimportant low levels, but sometimes, and apparently owing to rather insignificant abnormalities in weather conditions affecting the growth of the crops in relation to the development of the midges, outbreaks of these insects do occur on crops. Their numbers are then astronomical and frightening. Those who saw the clouds of Wheat Blossom midges, drifting like evening mist over the wheat fields of the south of England and especially Ireland, a few years ago just at ear-burst, will not forget the sight for a long time; nor will they forget the consequent experience of harvesting, from some fields, scarcely more corn than they had previously sown. Neither will those who have seen the bottom of the carts, in which they have been carrying red clover seed crops, red with larvae of the Clover Seed midge, easily forget the sight. Some idea of the colossal number that must be present on such occasions, and of the damage that is caused, can be appreciated when it is realised that each larva is only about $\frac{1}{10}$ inch in length and that each is responsible for the loss of a seed.

It is exceedingly difficult to make reliable assessments of the damage caused by gall midges. In outbreak years, the crop loss is obvious, but nearly always there is a diminution of yield, especially in seed crops. Work at Rothamsted has suggested that there are rhythms of abundance in the two Wheat Blossom midges, and there appears to be a tendency for increased numbers to be on the wheat every fifth year. This may have some connection with increased ultra-violet radiation. But, whatever is the cause, the regularity of these occurrences on a particular field or in a limited area cannot be expected not to be upset sometimes by local weather conditions

because of the close interrelationships of the midges and the wheat. These rhythms may well occur in many kinds of gall midges. Until it is possible for the authorities to give warnings of approaching peak years, the only general advice that can be given is to be scrupulous about good farming practice and to be ready to take any appropriate extra precaution whenever the numbers seem to be increasing. This necessitates the recognition of the pest in question. Rotation of crops in itself is not of much assistance in controlling gall midges unless there are dense tree barriers between the fields, since the midges drift considerable distances from field to field on light breezes. But such barriers cause sheltered patches which encourage successful egg-laying.

Hessian Fly The most notorious gall midge pest of cereals is the Hessian fly. Fortunately for farmers in this country, either the climate and weather or the practice of farming is such that this gall midge is rarely of importance. It may be of interest to record that in recent years a claim has been made that the Hessian fly, which occurs in Europe, including of course this country, is not the same kind as that which occurs in N. America. However, biological tests are shortly to be made in an attempt to decide this point, although it seems likely that the European and the American Hessian fly are but two biotypes or forms of the same species.

In the autumn and spring, young infested wheat plants may be recognized by having more erect, deeper green or bluish-green, broader, coarser and often shorter leaves than uninfested plants. The central shoot is often yellowish or missing, having withered away. During the summer, infestations are often recognizable by the ears being shrivelled or whitish, and by lodging just above a node. The presence of white larvae with a two-pointed anchor process, or brown puparia each containing such a larva, under the leaf sheaths just above a node on wheat, barley or rye, confirms the presence of Hessian fly. Another similar species occasionally occurs on oats, but its larva possesses an anchor process with a single point.

Young stems and tillers that are infested usually die. For this reason, wheat varieties that tiller freely have the best chance of survival, even though some of the tillers themselves may become infested. The initial damage to spring-sown crops is the same as that to autumn-sown plants, but in the spring the plants can more often grow away from the attack. In the summer the larvae and puparia are to be found up on the stems under the leaf sheaths just above a node. The stem sometimes breaks or lodges at these points.

Couch grass is an important weed food-plant for the midge in this country.

At present, good farm practice seems to be sufficient to prevent this midge from becoming a pest. In the U.S.A., resistant and tolerant varieties of wheat are being produced and grown successfully.

Wheat Blossom Midges One of these is yellow and the other orange. At ear-burst, they can be seen during still evenings, laying their eggs in the ears. Three weeks or so later, their larvae, also yellow or orange, can be rubbed out in the hands; although the orange ones are the more difficult to find since they are solitary, whereas the yellow ones are gregarious. By the time the corn is drying off, they have usually left the ears for the soil, where they spend the winter as full grown larvae in cocoons. Occasionally in dry seasons, such as 1955, many of the larvae are still in the ears at harvest and appear in the tail corn, since they are unable to leave the ears during dry weather.

The yellow larvae prevent the formation of the grain in the floret in which they are feeding; the orange larvae cause shrunken grain. Although the

yellow larvae are usually more abundant than the orange ones, it is the latter that are the more serious pest, since they reduce the quantity of good grain and because, when less than 5 per cent of the florets are attacked by the yellow larvae, compensation by the uninfested grain seems to take place.

These two midges seem to have a tendency to be more numerous about every fifth year. This is undoubtedly partly because there are good and bad years for their successful emergence as adults and for the subsequent egg-laying of the females. The latter cannot lay successfully if the weather is cold and rough for the season of ear-burst; they require warm, still and sultry evenings. Another requisite for successful egg-laying is that the wheat ears at the time of the midges' emergence from the soil are just bursting their sheaths. If the wheat is more, or less, advanced in growth, the midges cannot lay their eggs on it; the yellow ones then desert the wheat and lay their eggs on any couch grass that is available. The orange midges similarly go to any rye or barley that happens to be in the right stage of development. Other factors in these midges' numerical abundance are that the yellow midge can remain for four years as cocooned larvae in the soil, and that the orange ones can stay as long as thirteen years in the soil before emerging. Thus the larvae can accumulate in the soil until conditions are suitable for them to leave their cocoons and pupate.

When outbreak numbers of these midges are expected, the midges can be prevented from egg-laying by spraying with DDT, using long spray-booms, providing the application is made just before ear-burst. Another method that has given good results is the application of a mixture of kainit and calcium cyanamide in the open furrows, either in the autumn or spring. But in most years, no control other than good farm practice, including the eradication of couch grass, is necessary.

Saddle Gall Midge The larva of this gall midge is blood-red in colour and distinctly large compared with those of most other species. Its anchor process is very broadly rounded. The larvae are to be found under the leaf sheaths, in saddle-shaped depressions lying parallel to the long axis of wheat, barley, oat and rye stems, and usually on one of the topmost internodes. Lodging of wheat is not attributable to this gall midge since the attack is too high up the stems. Attacked stems are inclined to be more green and vigorous than unattacked ones. Stems near those that are attacked yield inferior straw and grain, presumably because their quota of sap is diverted to the infested stems by the continual irritation of the larvae. In wet weather, decomposition is likely to set in around the depressions made by the larvae.

Occasionally, very large numbers of the larvae are present and, in dry summers, they remain on the stems until harvest time. In such years, one gets reports that "sheets spread under the threshing-drum were quite red with the larvae".

The midges emerge from the end of May until July and lay their eggs on the topmost leaves available. On hatching, the larvae make their way down the leaves towards the stem and take up their feeding position under a leaf sheath on the stem. When full grown, the larvae descend to the soil if the weather is wet, or stay up on the stems until a dry spell is ended. They spend the winter in cocoons in the soil, only pupating in the spring shortly before the emergence of the midges.

As a rule, this species is not sufficiently numerous to attract attention, but in some years, such as 1955, it was very obvious because the larvae were still up on the stems at harvest and appeared in the screenings after threshing.

Part 2 of this article will appear next month.

INDOOR MECHANIZATION AND THE SMALL FARMER

R. B. WHALEY, A.R.I.C.S.

Agricultural Land Service, South-Western Province

Is the small farmer making the best use of indoor mechanical aids now on the market? Mr. Whaley examines a few which save labour and time in even the most out-of-date building.

AUTOMATION is very much in the news of late, and industry generally is finding it necessary to make costly changes and to reorganize methods of production in order to keep abreast of modern techniques. In considering this new industrial revolution, the casual observer cannot help wondering to what extent agriculture is taking advantage of mechanization and labour-saving devices, particularly in and about farm buildings. On some of the larger holdings and specialist farms, modern equipment is certainly being used extensively; but this cannot be said of the average farm, particularly the smaller holding and those in upland areas.

Farmers generally have taken very good advantage of the mechanical aids made available to them for their husbandry and field operations, but these are mainly based on the tractor. They have also tended to look to the tractor to supply the motive power for mechanization in and around the buildings, in the same way as they have for work on the land.

A modern tractor with the variety of attachments available can serve a very useful purpose about farm buildings, especially where the buildings are designed to take full advantage of their use. It is a matter of doubt, however, whether farmers are not relying too much on the tractor as a maid-of-all-work, and designing buildings solely to suit this one source of power.

That aside, there are many old buildings which, on economic grounds or because of the restricted nature of the site, cannot be adapted to allow the use of the tractor for mechanical aid. In these cases the buildings may be structurally sound, but grouped in a number of small units, and cattle may be housed or milked in two or three separate buildings. Here, particularly, the provision of other mechanical aids may well be a better proposition than attempting structural adaptation of the buildings.

There are many forms of mechanical aid today, but for our present purpose a few simple types merit mention as examples.

Overhead Conveyor This consists of a steel track slung from the ceiling joists, on which a bucket, suspended from small wheels running on the track, can convey loads up to 6 or 7 cwt. The conveyor is easily pushed to any place to which the track extends. The rectangular bucket is generally made of heavy gauge galvanized steel and is about 4 feet long, by 2 feet wide, by 2 feet deep. It can be raised or lowered either by a worm drive or endless chain device.

The tracks can be made to go round curves of about 3 feet radius, and branch lines with switches may be fitted to run into any building as desired. For crossing yards between buildings where there are no overhead joists, the track can be suspended from a larch pole of about 30-35 feet in length, or it can be carried on timber or tubular steel arches set at intervals of 10-12 feet.

It is also possible to fit the end of the track on to a swinging arm with a

radius of about 30 feet, if it is desired to dump manure, etc., into a larger heap than would be possible from a fixed tipping place. If the swinging arm is used it requires, however, some method of providing stays to hold up the floating end of the larch pole. Alternatively, it is more desirable, where manure can be carted on to land during winter, to run the track so as to allow tipping into trailer or muck spreader. Thus the manure can be moved without additional handling.

These conveyors, of course, can also be used for the distribution of silage from the pit in the yard to any of the farm buildings as required.

Various alternative attachments to the aforementioned manure bucket include food carriers and, either platforms for milk churns and milking utensils, or slings to convey individual churns of milk.

There are several suppliers who specialize in this type of equipment, though the design and cost varies according to the nature of the work required. Obviously a conveyor used for heavy loads like manure and silage would required to be more substantial than one used for lighter work conveying hay, cake, etc.

The installation of an overhead conveyor system is particularly worthy of consideration where the buildings are sited at different levels. In such circumstances, the provision of concrete passages and rubber-tyred trucks would not be a satisfactory solution, because of the need to traverse ramps and undulating yards, often with heavy loads.

Mobile Milking Plant Where dairy cows are housed in two or three separate cowhouses, and where the erection of a milking parlour or a single cowhouse to accommodate all the herd is not practicable, a difficulty often arises in the installation of the normal fixed milking machine. This difficulty can be overcome by the provision of a mobile milking plant. These plants are now supplied by most of the manufacturers of milking machines, and each one is a self-contained unit, driven by electric motor or petrol engine. The unit is mounted on a small trolley with the engine and vacuum pump housed in covered containers, generally lined to cut down engine noises and provided with a dispeller to disperse exhaust fumes. From the unit, pipe lines—which can swing in any direction—are fitted with the usual teat cups, pulsators, buckets, etc., and are worked in the same way as an ordinary fixed type machine.

Normally, two milking units are provided. The trolley works from the back of the standing, and the operator traverses from one end of the cowhouse to the other in the same way as with the fixed plant, moving the trolley as necessary.

Adaptations of the mobile milking machine can be used for outside work, where cows are still milked in the field. The unit is carried on a small trailer, which can be hitched behind a car with another trailer towed in the rear to carry churns and buckets.

A mobile auto-recorder unit, to work off an existing fixed vacuum pipeline, is also available. The advantage of this is that each cow's milk is automatically weighed, the milk is sealed from the atmosphere at all times and, with the use of in-churn coolers, the risk of contamination to the milk is greatly reduced.

Sack Elevators Most old sets of farm buildings are provided with lofts, and often have granaries at first floor level. A good many of these lofts or granaries are now put to little or no useful purpose; carrying

corn or hay up to first floor level is usually too much trouble with the reduced labour force.

Far more use could be made of these upper floors by the provision of a portable elevator, of which there are many now on the market. These are of a light-weight steel construction, easily manoeuvred and powered either by electricity or a small engine. They are extremely useful for conveying sacks of corn, fertilizers, cake, baled hay, loose potatoes or roots, either from a trailer or lorry to an upper floor, or from ground level to lorry. Once the machine is installed and running, the work involved is merely that of putting the loads on the conveyor at the bottom and taking them off at the other end.

Cowhouse Trolley In all cowhouses, but more so in the larger than the smaller, there is much fetching and carrying during the day's work, which is probably unnoticed by the worker until brought to his attention. It arises mainly in connection with small jobs like picking up udder cloths, washing down utensils, udder creams, etc., or in the weighing or recording of milk and booking the yields. It is only comparatively recently that somebody had the bright idea of carrying the various odds and ends along the cowhouse with the aid of what can best be described as an adapted form of tea trolley.

The trolley can be put together by any handyman, and may be of timber or tubular steel construction, with tiers of shelves. The top tier can be sloped in the form of a desk, on which the record sheets can be kept and filled in. The lower tier can carry udder cloths, ointments, etc. The frame at the top can be extended at one end to carry a spring balance or recorder, and at the other end similarly to carry a bucket. Fitted with stout wheels, the trolley is easily moved, the time spent in walking possibly halfway down the cowhouse two or three times for every pair of cows is avoided, and the trolley can be conveniently put out of the way when not required.

These few examples do not, of course, represent very advanced mechanization, but they all have the merit of low operating costs and would be worth using in suitable circumstances. For, in agriculture as much as in industry, automation is the keyword of the future.

★ ***NEXT MONTH***

Some articles of outstanding interest

Nitrogen for Wheat and Barley by C. V. DADD and E. R. BULLEN, N.A.A.S., Cambridge ● **More Beans for Stock-feeding?** by MICHAEL B. JAWETZ of the Department of Agricultural Economics, University College of Wales ● **Polythene in Horticulture** by G. F. SHEARD, Director, Fairfield Experimental Horticulture Station, Lancs ● **Bury Farm, Epping** by C. P. GAMAN, N.A.A.S., Essex, and L. H. HUNT.

VIRUS DISEASES OF INSECTS
THEIR USE IN BIOLOGICAL CONTROL

KENNETH M. SMITH, C.B.E., F.R.S.
Virus Research Unit, Agricultural Research Council, Molteno Institute, Cambridge

Some kinds of virus diseases which affect certain insect pests offer possibilities as an effective form of biological control.

VIRUSES attack all kinds of living organisms, but some have not been so thoroughly investigated as others. Until recently, for example, very little attention had been paid to those viruses which attack insects; this is all the more surprising in view of their interest and potential importance. So far as is known at present, there are three kinds of insect viruses, and in practically every case it is the larvae which they attack. A possible exception is the so-called "bee paralysis", which affects the adult insect and is thought to be caused by a virus.

The first and best known group of viruses cause the *polyhedral* diseases, or *polyhedroses*—so called because certain tissues of the insects become filled with polyhedral (many-sided) crystals.

The second group of viruses causes the *granular* diseases, or *granuloses*. In these diseases there are no crystalline inclusions but enormous numbers of extremely small granules which are just at the limit of vision with the optical microscope.

In the third group there are no crystals, granules or other intracellular inclusions but the virus particles occur freely in certain tissues of the affected insects.

Viruses have so far been found only in three orders of insects: Lepidoptera (butterflies and moths), Hymenoptera (ants, bees and wasps), and Diptera (the flies).

Polyhedral Diseases For some years considerable controversy centred round the polyhedral crystals, and various theories (mostly wrong) were suggested to explain their nature. One view was that the crystals were some kind of organism and were the causal agent of the disease. A second view (later proved correct) supposed the crystals to contain the virus within them. Fig. 1 on p. iii of the art inset shows the appearance of the polyhedral crystals, which are comparatively large and easily visible under the oil immersion lens of the optical microscope. That the virus is actually contained within the polyhedra can be demonstrated by means of the electron microscope. (Fig. 2.)

It has recently been shown at Cambridge that these polyhedral diseases of insects fall into two sharply differentiated groups. One of these is known as the *nuclear* type, because the virus multiplies inside the cell nucleus; the other is known as the *cytoplasmic* type, because the virus multiplies in the cell cytoplasm. In addition, each virus has its own characteristics; the nuclear virus is generally confined to the skin, tracheae and fatbody, and the effect of the virus is to produce a complete disintegration and liquefaction of the body contents. The virus itself is apparently always rod-shaped and the polyhedral crystal is enclosed in a thin membrane; when treated with weak alkali the crystal dissolves completely, leaving behind the membrane and the virus rods. Fig. 2 is a typical example of a nuclear polyhedral virus. In contrast to this, the cytoplasmic polyhedral viruses have so far always

been spherical in shape and in some cases composite in nature, each sphere consisting of groups of extremely minute sub-particles. They are usually confined to the cells of the gut. These crystals do not dissolve completely in weak alkali but leave behind a framework filled with circular holes which contained the virus. It is difficult to demonstrate the virus in the crystal by the use of weak alkali, as is easily done with the nuclear viruses, because the virus dissolves very readily and before the crystal does. Another technique, therefore, has to be used, and this involves cutting very thin sections of the intact crystals, which is a rather difficult procedure. If, however, the sections are thin enough the virus particles can easily be seen embedded in the crystal matrix.

The disease caused by the cytoplasmic viruses differs sharply from that due to the nuclear type. With the former, affected larvae cease feeding and eventually die, their bodies becoming flabby and gradually drying up. The latter disease is much more rapid and dramatic, the bodies of the larvae become virtually thin sacs filled with the liquefied contents and containing millions of polyhedral crystals. The diseased larvae are frequently found in a characteristic hanging position, being attached to their food plant by the abdominal feet. The bodies are very fragile and the skin ruptures at a touch, the extremely infectious polyhedra being thus spread all over the food plant. As we shall see later, this marked difference in the diseases caused by the two types of polyhedral viruses may have a considerable practical importance.

Granular Diseases Although this type of insect virus disease has not long been recognized, a great many granuloses have since been described. So far they have been found only in the caterpillars of butterflies and moths. As already mentioned, the affected tissues become filled with vast numbers of minute granules. These tissues seem to be usually the skin and fatbody, and the viruses appear to multiply in the nuclei. Treatment with weak alkali reveals the presence of a virus rod, usually one, sometimes two, inside the granule. Thin sections of the granules, however, show that the virus rod is contained within a second capsule inside the granule. This curious kind of Chinese box arrangement of rods within rods seems characteristic of the insect viruses. The disease caused by the granular viruses resembles closely the nuclear polyhedroses. The affected larvae hang in the same way by their abdominal feet, the skin ruptures at a touch and the body contents are liquefied in a similar manner.

Virus Diseases without Intracellular Inclusions Two or three diseases of this type have been described. They include the so-called "sacbrood" of honey-bee larvae, the virus paralysis of adult bees, a virus disease of *Cirphis unipuncta* (Haworth), the cosmopolitan "army worm", and a new virus affecting the leatherjacket. In this last disease affected larvae are much paler in colour than normal and a striking characteristic of the disease is the development of a bright violet pigment in the fatbody, which is the site of multiplication of the virus. The virus itself is ovoid or near spherical in shape and occurs in very high concentration in the diseased larva.

Specific Nature of Insect Viruses Some of the plant viruses are highly specific and will attack only a small group of related plants, whilst others, such as those of cucumber mosaic and tomato spotted wilt, have an almost unlimited host range. It is probable that something of the same sort holds good for the insect viruses; the polyhedral virus of the silkworm, for example, seems highly specific and, on the other

hand, a virus isolated from the caterpillar of the Painted Lady butterfly *Vanessa cardui* (L.) appears to infect a wide range of lepidopterous larvae. This question of cross-transmission of insect viruses raises an interesting problem. Among large numbers of cross-transmission experiments it frequently happens that a larva inoculated with a *nuclear* polyhedral virus dies of a *cytoplasmic* polyhedral virus. One explanation of this phenomenon is that large populations of caterpillars are naturally infected with a latent polyhedral virus which seems to be predominantly of the cytoplasmic type. Inoculation with a foreign virus stimulates into action this latent virus, with the consequence that the insect dies of its own latent virus and not from the virus inoculated. This phenomenon may have a practical application.

Some Virus Diseases of Agricultural Pests The number of separate viruses affecting plants now exceeds 300, and new viruses are recorded every year. If the number of insect viruses known is less than this, it is probably because less attention has been paid to them than to the plant viruses. Recently an intensive search was made at Cambridge for viruses attacking insects of agricultural importance, and it is surprising how quickly a virus for a given insect can be found if the search for it is sufficiently careful. Altogether twenty-six viruses affecting twenty-two species of insects were found, not all of which were newly described. Of these twenty-six viruses, eleven cause cytoplasmic, and eight cause nuclear, polyhedroses. Six are granulosis viruses and one virus has no intracellular inclusions. A short account is given here of one or two of these virus diseases.

Among the nuclear polyhedral viruses the most interesting was one attacking the leatherjacket. The virus causes a kind of leukaemia, or blood disease, and the number of blood cells in an infected larva increases to an enormous degree. This virus disease was first briefly described by Rennie in 1922 and was rediscovered at Cambridge just recently. The diseased leatherjackets have a characteristic pallor, and if a blood smear from one of these is examined under the optical microscope the blood cells will be seen to contain numbers of the "polyhedral" crystals. Actually these crystals are not polyhedral but shaped rather like a segment of an orange. In the expectation that the crystals would behave like the nuclear polyhedra of the lepidopterous larvae, they were treated similarly with weak alkali. However, instead of dissolving and leaving behind a thin membrane containing virus rods, they behaved in a most surprising manner. The crystals showed a remarkable elasticity and elongated until they resembled a nematode worm; when returned to distilled water, the crystals resumed their normal shape, and this process could be repeated indefinitely, provided the elongation was not allowed to exceed about three times the length of the crystal.

Since it was not possible to demonstrate the presence of the virus particles in the crystal by the alkali treatment, the same technique was applied as in the case of the cytoplasmic polyhedroses, and thin sections were cut off the untreated crystals. These revealed the presence of large numbers of rod-shaped virus particles within the crystal.

Cytoplasmic polyhedral viruses were found in a number of insects of economic importance; these included, among others, the larvae of the Turnip moth or cutworm, *Agrotis segetum* Schiff., of the Tomato moth, *Diataraxia oleracea* (L.) and of the Yellow Underwing moth, *Triphaena pronuba* (L.).

All attempts to find a natural virus infection of the larvae of the Winter moth, *Operophtera brumata* (L.), failed, but a virus affecting this species was eventually secured and it may be of interest to describe briefly how this was accomplished. In discussing the specificity of insect viruses, I mentioned

that sometimes a larva inoculated with a nuclear virus died of a cytoplasmic virus. This may be interpreted in two ways, either the inoculum contained both types and it was the cytoplasmic virus which multiplied in and finally killed the insect, or the foreign virus "triggered off" a cytoplasmic virus already present in a latent condition. Since we had failed to find a natural virus infection of the Winter moth larvae, the experiment was tried of infecting them with a foreign virus. Some hundreds of larvae of the Winter moth were fed on foliage heavily contaminated with nuclear polyhedra from the caterpillars of the Painted Lady butterfly, *V. cardui*. After 10-20 days, the larvae began to die of a virus disease, the final mortality being almost 100 per cent. Examination under the microscope revealed the presence of a cytoplasmic polyhedrosis. All the control larvae remained healthy. This experiment has been repeated several times, but not always with the same result; sometimes the inoculated larvae remained healthy. This suggests a stimulation of a latent virus which may not always be present, rather than a genuine cross-infection.

For the past four years, attempts had been made without success to find a virus affecting the caterpillars of the Large and Small White butterflies, *Pieris brassicae* (L.) and *P. rapae* (L.). However, during 1955 there was a very heavy migration of white butterflies, mostly *P. brassicae*, from the Continent, and it is suspected that among these immigrants were some which carried a virus within them and transmitted it through the egg to their offspring. The virus which was thus discovered was of the granulosis type and caused an extremely virulent and fatal disease. The virus apparently infects the larvae of all three species of white butterflies, *P. brassicae*, *P. rapae* and *P. napi* (L.), the Green-veined White. We are not yet certain, however, whether it is one virus which infects all three species or whether, in the case of the two latter species, a similar latent virus is stimulated into action. Affected caterpillars die rapidly and in the same manner as larvae infected with a nuclear polyhedrosis; the bodies hang down in a characteristic manner and the liquefied contents are easily dispersed over the food plant.

A similar granulosis virus has also been found infecting the caterpillar of the Dot moth, *Melanchra persicariae* (L.).

Viruses in the Control of Insect Pests The virulence and infectious nature of many of the viruses affecting insects suggest the possibility of using them to control insect pests of agricultural or economic importance in a manner similar to the control of rabbits by means of the myxoma virus. This method of biological control has already been tried with some success in other countries, as for example against the Lucerne caterpillar in California and the Pine sawfly in Canada.

Provided certain difficulties can be overcome, the use of viruses as a method of control has several advantages over the more orthodox chemical insecticide. First, unlike the chemical, the virus is highly specific for the insect at which it is aimed and will not destroy other harmless or beneficial insects such as parasites and predators. Secondly, and this is very important, the viruses are self-propagating, so that a disease once started will continue to spread, especially in crowded insect populations. Added to this is the probability that, in some cases, the virus is passed from adult to offspring, so that it is possible to reach generations yet unborn—a thing no chemical can do. Indeed it is conceivable that the virus might become established in a particular species and so, by means of periodic outbreaks, keep the insect numbers down to negligible proportions. Thirdly, the polyhedral viruses, at least, are more persistent than any chemical and will retain infective power under some conditions for periods of years.

VIRUS DISEASES OF INSECTS

In considering the application of viruses in the biological control of insect pests, there are certain essential conditions to be borne in mind. First, it should be possible to prepare the virus easily and cheaply in large quantities. Secondly, chances of success are greater if the insect feeds openly on its food plants. For example, we have at Cambridge viruses which attack the cutworm and also the leatherjacket, but the difficulties of applying viruses to soil-inhabiting insects are great. Thirdly, an important point concerns the suitability of the virus itself. I have pointed out in an earlier paragraph the different kinds of disease which are caused by the cytoplasmic and nuclear polyhedral viruses respectively. The former virus causes the larva to die, but the body becomes dry and desiccated; with the latter virus, on the other hand, the body contents become liquefied, the skin ruptures and the highly infectious polyhedra are broadcast far and wide. A similar disease is caused by the granulosis viruses. The practical importance of this difference in the diseases is clear enough; the polyhedra are not liberated from a mummified cadaver with the same ease with which they spread from a cadaver which is, in effect, a thin-walled sac filled with a highly infectious fluid.

In the granulosis disease of the caterpillars of the white butterflies, we have a virus which fulfils all these conditions, so that theoretically it is very suitable for use in the control of these insects. The virus is extremely virulent and infectious, the contents of the bodies of eight full-grown diseased caterpillars are sufficient to make one gallon of spray. The virus is easily prepared and, because it is possible to cultivate the caterpillars all through the winter by means of artificial lighting and heating, supplies of virus can be built up during the winter for use in the following season. Furthermore, the caterpillars are easily rceached by a spray, since they feed openly and in large numbers on the food plants. Added to this is the apparent inheritance of the virus by the offspring of infected parents which should greatly increase the efficiency of control. The effectiveness of this virus in field experiments against the caterpillars of the white butterflies is to be tested out during this and subsequent seasons.

National Malting Barley Competition

This old-established competition, organized by The Brewers' and Allied Traders' Exhibition, is being held this year at 15 Southwark Street, London, S.E.1, on October 11-12. Besides the Championship Cup there are medals, cash awards and diplomas in eight district classes, and a special threshed barley class.

The latest date for entries is September 24. Schedules, entry forms and full information can be obtained from The Trades' Markets and Exhibitions Ltd., 623 Grand Buildings, Trafalgar Square, London, W.C.2.

GROWING FREESIAS

R. L. C. Footitt

Patrixbourne, nr. Canterbury

Freesias have become increasingly popular with the British public in recent years and the demand for these fine flowers continues. In this article, a successful grower discusses the advantages of freesias and his own methods of growing them.

IN the last ten years, freesias have certainly upset the traditions of the flower market. Floral Hall used to be noted for conservatism. It was, and usually still is, difficult to get new introductions established. The commission agent prefers to handle well-known and free-moving lines. The florist is understandably reluctant to buy what he is uncertain of selling and what may have to be consigned to the dustbin after a few days. And the public, who in the last resort control the whole situation, are slow to accept unfamiliar flowers, or variations of current favourites.

But there was never any hesitation in accepting the modern freesia hybrids that came on the markets in quantity immediately after the war. Those few of the flower-buying public to whom the name freesia meant anything at all would probably remember *refracta alba*, the small, white, very highly scented freesia from Padua. Modern hybrids, with their greater size and wonderfully extended colour range, were quite new, and, for once, novelty was no obstacle. Freesias jumped immediately into popular esteem. Every year since the war the production of freesia bloom has been increased; every year it has seemed that freesias must at last be overdone, as every popular flower has been sooner or later. But every year the public has taken up all the freesias on offer and has asked for more.

Only a flower with exceptional virtues could produce such a demand. And the freesia certainly has outstanding qualities. Freesias seem geared to the character and tempo of modern life. With their clean, slender, stiff stems they are very quick and easy to arrange; they stand a long time in water, and the water does not get foul. The memory of *alba* no doubt induces people to think that only the white freesias are scented. This is not so. Though less odoriferous than the old *refracta alba*, modern varieties are still strongly scented, and a vase of them will perfume the whole house; their colours are bright without being in the slightest degree harsh or hard; they are not too big for modern small rooms, yet big enough to catch the eye; and finally they come at a time of year when there is not very much variety in the flower market.

Growing from Seed Freesias may be grown either from seed or from corms. The grower from seed gets the earlier crop and the best returns, but has to work much harder for them. Seed, which is rather expensive and shows no sign of getting cheaper—it costs between £4 and £5 per oz of about 3,000 seeds—should be sown in moderate heat at any time after the end of March. It should just be covered.

The seedlings will have to be moved about quite a bit, so that suitable containers must be chosen. Anything that holds a good depth of soil will do. Chip baskets have been used with success, but boxes are better, and 6-inch pots perhaps best of all. The plants should be about 1½ inches apart each way, or 7 to the 6-inch pot, and if possible the seed should be sown straight in the boxes or pots, one seed to each station. The seed is too

Photo: *R. A. Malby*

A flower with exceptional virtues.

Design of Pig- and Poultry-houses (Article on pp. 255-7)

Photo: *Raymond Holmes*

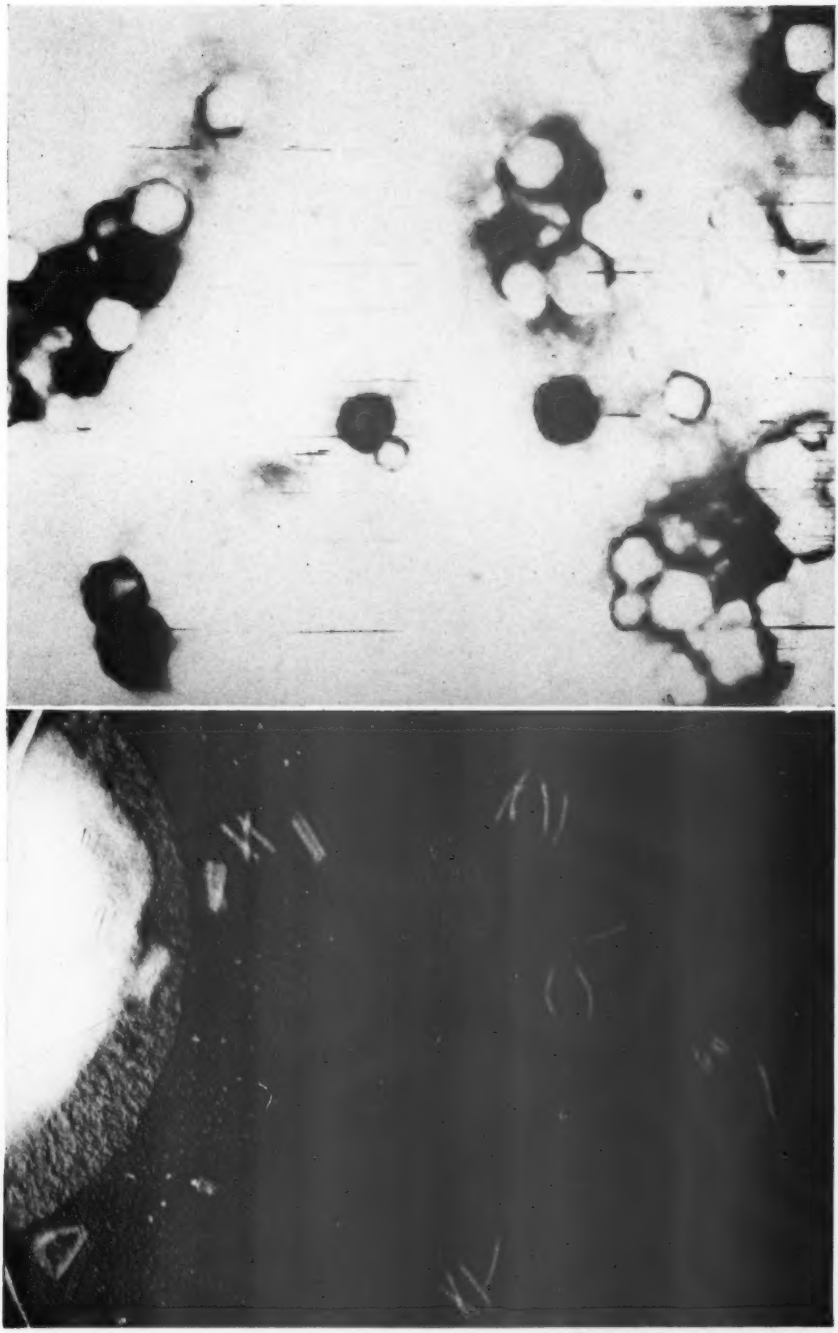
Good ventilation in a pig-house, using Danish-pattern extractor vents and hopper windows.

Indoor Mechanization (Article on pp. 268-70)

Photo: *R. H. G. Whaley*

Overhead conveyor from cowhouse to dung pit. On the extreme left is a sleigh conveyor from the battery house.

Virus Diseases of Insects (Article on pp. 271-5)



Photos: *S. Frey* and *S. Vernon-Smith*

Top: Polyhedral crystals revealed by the microscope (×1,200). When a nuclear polyhedra is treated with weak alkali, the virus rods are liberated (*bottom* ×25,000).

This was Scrubland (Article on pp. 258-60)

Mr. Cummins and the bulldozer driver plan the next operation.

valuable to broadcast and thin; but germination is good at 65-70°F and there will not be many misses.*

Alternatively, the seed may be scattered thinly in trays and the seedlings transplanted when 1-1½ inches high. This method has its disadvantages. If it is done with sufficient care, and at the proper time, there need be no loss of transplants, but some seed which is slow in germinating will be lost in the general disturbance. However, the transplanting technique demands much less space in the hot-house for the first two or three weeks after sowing, and is sometimes adopted for that reason. The potting compost most generally used is John Innes No. 1. The writer's private recipe is based on this formula, but replaces peat with vermiculite, and J.I. base with a mixture of dried seaweed and a bacteria culture on something that has the appearance of soot, but is probably quite different.

Standing Out Towards the end of May, the plants may be stood out in the open. A short sojourn under frames is very desirable to break the jump from hothouse to fresh air, but it is not essential for late-sown plants which will not, in any case, have to face the climate until the time for cold nights has passed. What is essential, however, is a hard surface under the pots or boxes on the standing-out ground. Freesias produce long taproots that will find their way down to a great depth if given the chance, and then are bound to be broken when the containers are moved in the autumn for housing. A broken taproot causes premature and poor flowering, so its descent into the underworld must be prevented by a barrier of rough concrete, brick or other impervious material that will none the less permit drainage from the pots.

The only other point to remember about the standing-out site is that it must be handy for water. The plants will need watering every day, and twice a day in hot weather.

Housing When the plants are finally housed in September, they may be left in their pots or boxes, or they may be knocked out into the beds. Leaving them in their containers is the lazier practice, and it is some protection against that bugbear of the freesia grower, *Fusarium*. But knocking them out means better blooms and a longer season. Either way, support will be necessary for the flower spikes, and is normally provided by two horizontal grids of fillis or thin plastic-covered wire. One grid should be about 6 inches above ground or pot level and the other 18 inches above that. The temptation to postpone fixing these grids until the plants look as if they need them must be firmly resisted; delay will only increase the difficulty.

Pipe heat will probably not be needed at first, particularly if the house is lined with polythene for heat insulation. Freesias like a temperature of 55-60°F, so that even in cold weather their fuel demands are very moderate. Watering should be done at all times from below so that as little as possible of the foliage is wetted. Trickle irrigation is useful, provided the points of water emission in the harness are close enough; the normal spacing of one nozzle every 18 inches is not satisfactory.

Blooms should be cut when the first floret is fully open. On well-developed plants, the flower-stem will have three or four branches, each ending in a flower-head of several buds. The freesias imported from Holland are normally cut to the base of the stem, the flower potential of the

* Large-scale growers of freesia frequently chit the seed by soaking for 24 hours and then placing in damp peat or sand at 70°F for about 14 days. The chitted seed is then sown at once direct into beds or pots—otherwise it is liable to dry out and die.—*Editor.*

Mr. Cummins and the bulldozer driver plan the next operation.

branches being sacrificed for the sake of a long stalk. The British practice, however, is cut as far as the next branch down, thus harvesting several blooms from one stem.

Not all first-year plants flower so prolifically, however. There seems to be a very wide difference in the vigour of the seedlings, so that although some produce flower-spikes as big and as multiple as *Gladioli primulinis*, others manage only a very short stem with but one or two buds. In addition, there seems to be a colour linkage with length and vigour. All the reds, developed from the small *Armstrongii*, are short, while the whites and creams are medium and the yellows and purples generally long and sturdy.

Growing from Corms Provided the crop remains healthy and mildew is kept at bay, flowering will begin in October and will continue for about five months. By this time, corms will have formed some two inches below soil level. If these are required for planting up or for sale, the foliage should be allowed to die down and the corms, cleaned of root matter and dead tops, stored in open trays in a well-ventilated room at 80°F. This is the commercial practice. Amateurs leave their corms lying around the potting shed in an old cardboard box, and appear to achieve equally good results. But if these results are properly scrutinized it will probably be found that only a proportion of the plants have flowered; some of the corms will be blind as a result of the treatment.

Corms, whether stored under proper temperature control, or left under the potting shed bench, or purchased from a wholesaler, should be planted up in August. When new stock is bought, it is an economy to order medium-sized corms rather than top size; with proper treatment they will flower just as well. Again, they are best in the glasshouse beds, but they may be planted in boxes, such as old bushel boxes, that give a really good depth of soil. They should be two inches deep, that is, their tops 1 inch from the surface, and not less than 1½ inches apart each way. Close planting is not advisable, however, unless the soil is rich in organic material. No heat will be needed for several weeks, and then should be provided in moderation, and at first only at night, to maintain about 55°F.

Under these conditions, flowering may be expected to begin in February. Artificial heat is not essential, however. Freesias may be flowered from corms under cold glass, provided only the worst of the frost is kept out—slight frost will be tolerated. But cold grown Freesias will not flower before April, which is too late for the highest returns.

Supporting grids are, of course, necessary: indeed, more so with plants grown from corms than with plants grown from seed, since the former invariably topple over unless supported, even before the flower-spike comes through. It used to be thought that once the plant toppled it would not flower, but this, like many another gardening dictum, is not in fact correct. But, naturally, the flower-stem from a plant grown on the horizontal will not be particularly elegant.

The cutting of the blooms and the treatment of the plants after flowering is as already described. When lifted, the corms will have formed a quantity of spawn, which can be grown on if desired. It will flower the first year, but rather later than the flowering from full-sized corms. Thus, even without growing from seed, freesia stock increases rapidly, and it is not surprising that the cost of corms has fallen heavily during the last two years. Some named varieties are still expensive, but mixed hybrids can be bought for as little as £6 to £7 per 1,000. Seed is sold by colour rather than by named varieties, the usual colour divisions being white, yellow and orange, pink and red, purple, and, of course, mixed; that grandiloquent term "Rainbow

Mixture" has unfortunately taken firm root in the catalogues. For the small grower mixed seed is the best proposition, because better quantity rebates are thereby secured, and there is no disadvantage in bunching mixed colours. In fact, the mixed bunches often sell when the self-coloured are left on the stands.

Marketing For local markets, bunches of six or eight are sometimes required, especially during the early part of the season when prices are high. For London, however, the regulation bunch is a dozen. There is no regulation box. Small cardboards are best, but carnation boxes are often used. The bunches are rather awkward to secure, and they need to be held firmly. Straps across the stems, stapled down to the box, are a considerable help.

THE MINISTRY'S PUBLICATIONS

Since the list printed in the June 1956 issue of AGRICULTURE (p. 129) the undermentioned publications have been issued.

MAJOR PUBLICATIONS *Copies are obtainable at the prices quoted from Government Bookshops or through any bookseller.*

Bulletins

No. 54 Rearing of Chickens (*Reissue February 1956*) 3s. (3s. 3d. by post)

Other Publications

Experimental Husbandry. No. 1 (*New June 1956*) 3s. (3s. 3d. by post)
Welsh Land Settlement Association—Report and Accounts: 1954-55 (*New June 1956*) 2s. 6d. (2s. 8d. by post)

LEAFLETS *Up to six single copies of Advisory and Animal Health Leaflets may be obtained free on application to the Ministry (Publications), Soho Square, London, W.1. Copies beyond this limit must be purchased from Government Bookshops, price 3d. each (4½d. by post) and 2d. (3½d. by post) respectively.*

Advisory Leaflets

No. 18 Cabbage Root Fly (*Revised June 1956*)
No. 395 Hay and Haymaking (*Revised May 1956*)
No. 451 Wasps (*New April 1956*)
No. 453 Mixing Feedingstuffs on the Farm (*New June 1956*)
No. 454 Herbage Seeds Mixtures (*New May 1956*)

Animal Health Leaflets

No. 32 Pulpy Kidney Disease or Enterotoxaemia of Sheep (*Revised May 1956*)

FREE ISSUES *Obtainable only from the Ministry (Publications), Soho Square, London, W.1.*

Farming Topics

No. 12 Wet Land: Poor Crops (*New April 1956*)

Farm Machinery

No. 13 Ventilated Silo Grain Driers (*Revised June 1956*)

Miscellaneous Leaflets

Carbonate of Lime (*Revised June 1956*)
Farm Institutes (*New June 1956*)
Full-time Agricultural Education in England and Wales (*Revised May 1956*)
Subsidy for Fertilizers (*Revised July 1956*)
The Safe Use of Poisonous Chemicals on the Farm (*Revised May 1956*)

CHEMICAL DESICCATION OF RED CLOVER FOR SEED

STANLEY A. EVANS, B.SC., DIP.AGRIC.

N.A.A.S. Liaison Officer, A.R.C. Unit of Experimental Agronomy, Oxford

Recent trials have shown that the use of chemicals to defoliate red clover before combine harvesting the seed may help the grower to avoid some of the difficulties caused by bad weather.

ONE of the principal hazards of harvesting red clover for seed is unfavourable weather. For example, in the dry, sunny autumn of 1955, many farmers harvested their seed by combine harvester direct from the standing crop, but in the wet autumn of 1954 many crops were abandoned. Management can procure the seed crop early in the autumn, during the longer days and better weather, and, under reasonable conditions, the traditional method of harvesting—cutting, cocking, stacking and threshing—will usually mean less seed lost and, possibly, a better sample than that obtained from direct combining. An unsuitable moisture content in the crop, faulty adjustment of the machine and an excessive forward speed may account for much of the loss sustained during combining. Direct combining, however, has been widely practised in recent years, chiefly because of labour difficulties and also in order to take advantage of fair periods during unsettled weather.

Defoliation and Drying Out In 1954 and 1955, the Agricultural Research Council Unit of Experimental Agronomy, the National Agricultural Advisory Service and the National Institute of Agricultural Botany undertook co-operative experimental work on the use of chemicals for removing the leaf and drying out the stems of clover. This process, already tried out with some success in the U.S.A. and Canada, was meant to assist direct combining in two ways: first, by reducing the bulk and the moisture content of the material that had to pass through the combine; and second, by leaving the seed heads in a suitable environment for rapid drying. Chemical treatment must obviously have no adverse effect on the seed, and the N.I.A.B. undertook to make seed tests.

Twenty-three trials were made, either on small plots to assess the effectiveness and speed of action of various chemicals, or on plots large enough to determine the effect of desiccation on combine harvesting. The chemicals tested were diluted with water (except where otherwise stated) and were as follows:

Chemical	Doses (*lb per acre*)	Volume Rate
Ammonium sulphamate	5, 10, 20 and 40	20 gallons
3-amino-1,2,4-triazole	1, 2, 4 and 8	20 gallons
disodium-3,6-endoxohexahydrophthalate (" endothal ")	½, 1 and 2	20 gallons
DNC (oil emulsion)	2, 4 and 8	20 gallons
pentachlorphenol (oil emulsion)	2, 4 and 8	20 gallons
pentachlorphenol in diesel oil	5	15 gallons
potassium cyanate	5, 10 and 20	20 gallons
sodium chlorate	5, 10, 20 and 40	20 gallons
sulphuric acid as undiluted B.O.V.		20 gallons
sulphuric acid	5, 10 and 15 per cent vol/vol	100 gallons

The pressure of spraying was between 30 and 50 lb per square inch.

Factors Affecting Penetration Chemical desiccants kill only that part of the plant which they hit, and penetration of the spray into the foliage is therefore important. In practice, the factors which effect penetration are the volume rate of application, the pressure of spraying and the type of spray nozzle used; but these factors were not examined, the pressure and volume rates chosen being those which were likely to be used by a farmer with his own low-volume spraying machine.

Four of the chemicals produced consistently good defoliation in the series of trials. These were:

DNC as oil emulsion (at 4 lb or more per acre)
pentachlorphenol in oil (at 5 lb per acre)
sodium chlorate (at 40 lb per acre)
sulphuric acid (either as undiluted B.O.V. at 20 gallons per acre or as 10 per cent or 15 per cent v/v solution at 100 gallons per acre).

All produced a rapid and extensive desiccation of the crop, the kill of leaf being complete, although the effect on the stem was never more than that of partial desiccation. Too brittle a stem, however, is not desirable because of the risk of losing seed heads. The rates indicated are those which gave the best results, but further investigations are required with pentachlorphenol to find out whether rates of less than 5 lb per acre will give equally satisfactory results. Other treatments were inferior in their ability to dry out the clover.

Advantages The full effect of DNC oil emulsion, pentachlorphenol in oil and sulphuric acid as B.O.V. or as a 10-15 per cent solution was seen within 4 to 7 days of application, while sodium chlorate took 7-10 days. But the trials showed that maximum desiccation was not necessary before combining could take place, a period of 3-5 days generally being required between application and combining when using the materials with the quickest action. The treatments which produced the greatest degree of desiccation made combining easier and quicker in both the wet season of 1954 and the dry season of 1955. In at least one trial in 1954, the use of a chemical desiccant enabled combining to be done although the nearby untreated crop had to be abandoned.

The effect of treatments on seed quality was negligible. There was a very slight indication that treatments producing satisfactory desiccation of the crop tended to increase the proportion of hard seed, but there was no consistent indication of adverse effect on total germination capacity. There was no evidence of any treatment causing significant mortality among the clover plants.

Disadvantages Unfortunately, some of the chemicals which produce good results have certain disadvantages. DNC is poisonous to man and animals, and its use is governed by the Agriculture (Poisonous Substances) Regulations, 1956. It is also important that no part of a crop which has been treated with DNC should be fed to stock after threshing, nor should stock be allowed into the harvested field until the DNC has disappeared from the stubble. The use of sodium chlorate produces a fire hazard. In other countries, sodium chlorate, combined with borax as a fire suppressant, is said to give satisfactory results, and trials to be carried out again this autumn are to include treatments with sodium chlorate combined with fire suppressant. Sulphuric acid is not poisonous and does not present the fire hazard of sodium chlorate and, were it not so unpleasant to use and if it did not corrode machinery, it would probably be widely used. Pentachlorphenol is only about a quarter as toxic as DNC, has no fire hazard,

and is not dangerous to handle like acid. It is probably the most promising chemical for general use. Dissolved in tractor fuel or diesel oil, and applied at 15 gallons per acre, it can be used in many of the low-volume machines owned by farmers, although in some machines the oil may be detrimental to rubber components.

Timing of Application One of the problems raised by the use of a chemical desiccant is the timing of the application. The seed never matures evenly throughout a crop: flowering and the setting and maturation of seed progress together over a period. But the effect of a chemical desiccant is to arrest any further development of the seed. It does not accelerate ripening and, therefore, it is important not to spray too soon, otherwise there may be a large proportion of immature seed in the harvested crop. Normally, the crop would be sprayed when the maximum yield of mature seed can be expected, but it is necessary to realize that the use of a chemical desiccant is only an aid to the harvesting of seed, and consideration must be given to weather conditions. Indeed, one benefit of a desiccant is that it should allow advantage to be taken of a short period of dry weather. Under very dry conditions, there is the possibility of some loss of seed through shattering if the period between desiccation and harvesting is too long.

The effect on insect life of the use of chemical desiccants on clover crops is not known. Bumble bees are important pollinators of red clover, and any killing of late bees may have an effect on the population the following summer. This requires investigation.

Comparative Values Finally, there is the question of cost. Based on current prices, the cost of materials to the farmer is roughly as follows:

	s.
13 gallons B.O.V. (for dilution with 87 gallons water to produce 100 gallons of 10 per cent solution)	26
40 lb sodium chlorate	33
4 lb DNC (oil emulsion)	37
20 gallons B.O.V.	40
5 lb pentachlorphenol (as emulsifiable concentrate)	56

Pentachlorphenol is obviously costly to use, and the cost of oil must be added to the price of the chemical. Pentachlorphenol is available to the farmer at present only in emulsifiable formulations, which are rather expensive, although pentachlorphenol itself is relatively cheap. Further trials may show that less than 5 lb of chemical will give satisfactory results, and it is not improbable that the cost of using pentachlorphenol can be appreciably reduced.

In the trials, DNC oil emulsion at less than 4 lb per acre and diluted entirely with water did not give consistently satisfactory results. A suggestion is made in the Weed Control Handbook 1956* that the rates of application might be reduced to 2 lb DNC, with the addition of 1-2 gallons per acre of diesel oil to the concentrate before dilution, to help improve the results. In that case, the cost of material would be considerably reduced.

The uncertainty of the yield and of the price the grower will get for his seed may make it difficult to decide when the use of a chemical desiccant is justified. Obviously, the cheaper the material, the more likely is it that the technique will be adopted. The trials have shown that chemical desiccation of red clover for seed can be a practical proposition in England, and that

* *Weed Control Handbook 1956*, available from the British Weed Control Council, Cecil Chambers, 86 Strand, London, W.C.2, price 5*s*.

there are chemicals that will act quickly and efficiently. What is not clear is the comparative value, in terms of economics, of the new technique with the accepted methods of harvesting. In addition to the cost of spraying, there are labour requirements, seed yields, cleanliness and quality of seed, necessity for drying harvested seed, and so on, to be taken into account. There is, nevertheless, a growing interest amongst farmers in this new practice, and even in such a favourable season as 1955 many growers used a chemical desiccant. The technique, however, has not been developed far enough to be able yet to recommend the use of a chemical desiccant in all circumstances—as, for example, in the laid and heavy crops often obtained with late-flowering red clover. Trial work is accordingly continuing.

[NOTE: Sodium arsenite was also tested in the series of trials and found to be effective but, because it is highly poisonous, it is *not* recommended for clover desiccation.]

ACKNOWLEDGEMENTS

The trials reported in this article were co-operative work undertaken by the Agricultural Research Council, Unit of Experimental Agronomy; the National Agricultural Advisory Service and the National Institute of Agricultural Botany. Acknowledgement is made to the officers of these organizations who participated in the work and to the farmers who made their crops available for the trials.

FORESTRY ON THE AGRICULTURAL ESTATE

R. E. DOWSE, F.R.I.C.S., F.L.A.S.

Agricultural Land Service, Yorks and Lancs Province

Almost every rural property includes some woodland. If the trees are to be an asset to an agricultural estate, they must receive much the same care and attention which is devoted to the Home Farm crops.

ENLIGHTENED woodland management should be complementary to agriculture, especially in the temperate climate of the British Isles, which is, generally speaking, particularly suitable for trees. In the past, much of Britain was covered by primeval forest and, as a result, many of our steep slopes and much of our poor land are under trees today. In the course of time, the woodland was gradually cleared elsewhere, and there was little conscious forestry practised until quite recent times.

During the eighteenth and nineteenth centuries, trees played an important part in landscape gardening on the grand scale, and towards the middle of the period, when sporting requirements became increasingly important, game coverts were planted extensively.

Owing to the rise in the population and the consequential development of natural resources, our woodlands shrank rapidly as the land was brought into agricultural use. As the natural sources of home-grown timber grew less, we came to rely more and more upon importations of deal from natural forests in Russia and the "New World". But all the time silvicultural methods at home were making gradual progress, and many agricultural proprietors valued their woodlands highly.

In times of national emergency, when this country has to rely largely upon its own resources, there can be no shadow of doubt but that home-grown timber is essential to survival. The First World War really brought the acute shortage of natural timber in this country to everyone's notice. As a result of the near-famine of timber, the Forestry Commission was born.

Amenity and Profit But in addition to historical associations and national requirements, trees confer other benefits. It would surely be impossible to imagine our countryside, with its wide views and unrivalled scenic beauty, without trees. They are essential to the enjoyment and amenity of rural areas. Similarly, the magnificent effects produced by avenues and groupings of trees upon agricultural estates is a part of our heritage. But trees are a crop, and this heritage requires renewal by every generation.

Nor should the question of profit be ignored. A recently published report on hedgerow and farm timber,* by a committee chaired by Lord Methyr, shows that in most areas of moderate rainfall it is profitable to plant and preserve small spinneys in the awkward corners of our fields and individual, well-spaced trees in the hedgerows. If the land is suitable, the planting of poplar on rather low-lying sites can likewise be most advantageous.

Practical Uses In upland and hill areas, grazings can get direct benefit from woods and shelter-belts. It is necessary to study the configuration of the ground and the direction and force of prevailing winds and, of course, soil types, before deciding upon the shape and extent of such woods or belts. But there is no need to plant the trees in geometrical patterns; on the contrary, the boundaries of these plantings should follow natural contours and be irregular in outline. The species of trees used can well be intermingled to produce a pleasing effect as well as a profitable return.

It should not be overlooked that in many of these hill areas much of the land forms the watersheds of rivers. Soil erosion is always a possibility. But judicious plantings of trees, particularly in areas of high rainfall, can largely overcome it, since the tree roots hold and bind together the soil and rocks, and act rather as a sponge, releasing water gently and quietly from beneath the shade of the trees, thus preventing the sudden and disastrous flood.

Another use of shelter-woods and -belts is to prevent wind erosion in the dry and light-land areas on or near the east coast. Such belts in flat country can well possess an added advantage for sporting purposes.

There is often a tendency to grudge enough land for tree planting to be really successful. Effective silviculture demands that a high proportion of trees which are intended as the final crop should not be on the outside of the wood or belt but should have a straight and clean bole created by natural competition with neighbouring trees for light and air. Furthermore, it must be the aim to be able to fell part of the wood or belt, and to replant that portion or portions without materially reducing the shelter afforded.

Altitude, soil and weather will largely govern the degree of importance which silviculture should have. Sometimes, it may well be enough that trees should grow to afford shelter for livestock and for an "early bite". Otherwise, at low altitude and on better soils, there is no reason why excellent quality timber should not be produced.

It is suggested, therefore, that shelter-belts containing two age-groups of trees should not be less than 100 yards wide. The value of ground cover should not be lost sight of, and hedges, too, are valuable where they will grow readily and can be economically managed. If dead fences are decided upon, then it is an advantage to plant groups of shrubs near the outside of these belts.

---

* *Report of the Committee on Hedgerow and Farm Timber, 1955.* H.M. Stationery Office. Price 3*s.* 6*d.* (3*s.* 9*d.* by post).

Rough Timber Practically all agricultural estates are able to supply "timber in the rough" for repairs to agricultural buildings and for fencing. Much of this material can be used by farmers and their men for small repairs and for patching or renewing fences, but it must be cut out of the new plantations as thinnings in order to allow for the proper development of the "crop". Scots Pine poles about three to five inches in diameter, barked and, if possible, treated with preservative under pressure, can, for example, make excellent material for fencing, and can be erected by unskilled men during slack periods in farm work. Hardwood thinnings and larch are equally effective.

On many estates, the farm agreements provide that the owner shall supply material for fencing while the tenant does the carting and the work of erection. Nothing could be more sensible and economical.

There should be considerable saving in cost between the provision of this material and the purchase of sawn deal, metal and concrete posts or wire. By simple methods it is often possible to convert the smaller trees into gate posts and to "run out" gate stuff on a small sawbench when the weather is bad and the men must work under cover. In this way, the ever-mounting cost of maintenance upon the agricultural estate may be lessened and the benefit of forestry becomes apparent.

Capital Asset and Tax The possession of reserves of growing timber is a capital asset upon any estate, particularly during times of high taxation and death duty. The taxation of woodlands is also of interest. Perhaps the only example of an income which does not directly attract payments of tax is the growing woodland assessed under Schedule B (or in some instances, under Schedule D, as, for example, where an initial loss must be expected on a new plantation). Certainly there are advantages for the landowner in not having to meet estate duty in terms of money on woodlands until the timber is sold.

The picture would not be complete without reference to the sporting interests, which rely so much upon the smaller plantations and groups of trees to make warm roosting places for pheasants and "stands" for driving birds over the guns. Forestry upon the agricultural estate must be practised with consideration for both agricultural requirements and sporting values. Likewise, agriculture and sporting interests must realize that trees are a crop which, in due season, must be harvested. With a little mutual understanding, there is no reason why these interests should not prove complementary.

Disadvantages There is a strong case for forestry upon the agricultural estate, but there are some common pitfalls and difficulties in its practice under these circumstances. The marketing of timber presents serious problems and much uncertainty. The first consideration should be the sale of the bulk of the thinnings, for which local markets are usually necessary, and which with care can often be worked up. The growing practice of using smaller sizes of timber for roofs under new techniques of construction may well be a profitable outlet.

The final crop on a 50- or 60-year rotation is always a doubtful proposition, but surely the augury is not bad. The uses of timber or bulk cellulose appear to multiply rather than diminish. The supply is being used up, even on the basis of present levels of population, at a greater rate than it is being produced. Except for periods of depression or exceptional economic restriction, the trend of values should, therefore, be upwards rather than the reverse. It would be encouraging to those about to invest some capital in new woodlands to be rather more sure of the eventual outcome, but this is a

"growth" stock in more senses than one. Much more attention should be paid to the proper marketing of timber from agricultural estates. There would seem to be advantages in co-operative methods to meet trade requirements.

The felling of mature timber provides other problems; fences and roads are often unavoidably damaged, and drains and culverts easily break down under unaccustomed weights. Some of this damage can be avoided by careful planning of extraction routes and by strict contract conditions; the remainder must be a charge against the value of the crop of timber.

There is sometimes a good deal of feeling regarding the liability for the maintenance of "woodland" fences. With the smaller plantations so usual upon agricultural estates, the costs may prove quite a burden for the owner. On the other hand, the common law that one must fence against one's own stock can mean a decided hardship to the farmer whose land is partly surrounded by woodland. The liability should be clearly allocated as between the parties in accordance with the estate custom and tradition. Often the owner accepts the lion's share of fencing of woodlands and this cost is then a charge upon the timber.

In the eastern parts of the country where the rainfall is slight, damage to both arable crops and to grass may result from the roots of trees and from their shade. Particularly is this noticeable when hedgerows are closely studded with elm. In these districts, modern agricultural methods have not favoured the retention of many trees in hedgerows, and, indeed, some hedges have themselves been grubbed up. Care must be taken not to upset the balance of shelter for the land in these areas, and it would seem profitable to accept a certain amount of shade and consequent crop damage by drought in order to avoid the surface soil "blowing" during dry periods when the land is being prepared for arable cropping.

In this country trees are inevitably with us, we like them, and must learn to use them to our best advantage for profit, sport and amenity. There is scope for much more forestry among agricultural estate owners, many of whom would profit from more modern woodland management. To this end, in addition to private consultants, there are experienced officers of the Forestry Commission available for general advice. A recent publication *Grants for Woodland Owners** gives details of money grants available to assist in both the planting and maintenance of private woodlands.

* Obtainable free from the Forestry Commission, 25 Savile Row, London, W.1.

ESTATE AND FARM ROADS IN THE OLD DAYS

G. E. FUSSELL, F.R.HIST.S.

Our farming ancestors may have considered that mud and deep ruts were natural hazards of farm roads, but they nevertheless knew something of how roads should be made and maintained.

MANY travellers in the southern counties will know the road from Newbury, in Berkshire, to Whitchurch, in Hampshire. It is a wide, modern highway with a good surface for motor traffic. Yet, in comparatively recent times, and within my memory, it was little more than a lane with two ruts made by wagon wheels and a third pounded out by the patient tread of horses. Grass flourished on the humps between the ruts.

The road must have been much the same for hundreds of years, like most parish roads and nearly all estate and farm roads of its time. In some, the ruts were so deep and long-established that cart and wagon wheels had to be spaced to fit them. A century ago only one inch of variation was allowed in the track of a new dung cart or wagon. The measurement was 5 feet 10½ inches. A description by George Bourne shows how necessary it was to have so fine a measurement. "Two parallel ruts went all down the lane, deep as the hub of a cart wheel. Many carts, for many years perhaps, had followed these; and plainly the lane would be impassable for any cart or waggon with wheels too wide asunder or too narrow."(1)

Yet a lot of farm roads and minor highways are not much different now. The ruts are still there, made by tractor tyres; only the centre rut, where the horses trod, has passed.

Some Early Advice Fitzherbert (1523) knew how costly bad roads could be in slowing down and making transport difficult. No water, he said, must stand on a road; all that fell on it must immediately run off. In summer, a wise man filled up every low place with gravel or stones, "somewhat dyscendynge or currante, one waye or another". If there was no gravel or stone he used earth, which would harden under traffic. Fitzherbert did not approve of ditches on both sides of the way. When heavy rain fell, it soaked through the gravel and the earth beneath swelled with moisture so that the gravel sank into it and was useless. The water did not, in fact, drain away.(2)

No farming writer appears to have ventured upon the subject after this until Richard Bradley discussed it in 1727. He quoted Fitzherbert, but added some useful observations. Farm roads were in general no better than before. Some were so bad in winter that farmers could not carry their corn to market when it was most wanted, losing a good sale "besides the hazarding of a man's life sometimes".

Bradley was writing (3) just as the enclosure movement was gaining impetus. Some estates had been well laid out, but, on others, drift ways and roads took up too much space and were not well directed. On the heavy corn lands, roads were usually bad in winter mainly because the farmer had no leisure for repairs in summer. Moreover, hedgerow trees shadowed them from the sun, dripped upon them in wet weather, and shedded masses of leaves in autumn, thus keeping the roads in a continual poach and mire. The first thing to do, advocated Bradley, was to cut down the trees so that, when the roads had dried, repairs could be made.

Bradley's road-mending methods were simple. First, the ruts had to be levelled with mattocks or pickaxes. After that, the holes were filled with

brushwood or faggots of broom laid " cross hollow ": if laid lengthwise the bavins were useless. If gravel or broken stone was handy, the wood could be covered with it. In boggy places that could not be drained, he suggested several layers of faggots, each crosswise upon the other; and, when a bottom was found, a layer of stones two feet thick should be placed on top. This material could even be used on chalk, though it was slippery unless covered with a layer of gravel.

Bradley, like Fitzherbert, emphasized the economic value of good farm roads which saved horseflesh, servant's time and trouble, and wear and tear of wagons and gear. But there was one advantage of a good road through an estate which he did not think of—namely, that travellers keep to it. If the surface was bad, horsemen were apt to break through the hedges and ride over good land, pasture and tillage, and do much damage. Matthew Stevenson in 1660 (4) had suggested banks and hedges to prevent this.

Edward Lawrence, in 1727, addressed his remarks on road repairs to the estate steward, one of whose manifold duties it certainly was. The great difficulty, he said, was to lay and keep roads dry; the surface should always be high and round in the middle. This could easily be arranged by throwing up spoil from the ditches. When it was settled at midsummer, he advised a cover of the best gravel, stones or rubbish obtainable. If done with judgement and skill, roads, formerly impassable even in summer, became fit for a galloping horseman in winter. (5)

New Ideas The theory of farm road-making did not change very much until the end of the eighteenth century, although in the meantime the great road-makers, Blind Jack of Knaresborough, Telford and Macadam, had been exercising their talents on the main and turnpike roads. Their methods naturally influenced a few builders of estate and farm roads, but most people were still satisfied to repair these ways in the rather slight traditional manner.

If a road had been neglected for a long time, the ruts were sometimes ploughed out. Some parishes kept for this purpose a special heavy plough with a long mould-board, but if the road was too full of stones or rubbish, the plough was useless. The alternative was hand labour. The road was laid as high as possible in the middle, as Lawrence had suggested. For all flats, falls or rills, a ford of hard stones was advised. If that was not practicable, the level was raised and a covered drain made underneath, using large flat stones as bridgework.

In level, or nearly level, lanes it was suggested that the track be made in the middle, but if one side was higher than the other, then the higher side should be strengthened, thus providing natural drainage. One farmer was considered ingenious by John Mordaunt (1761) because he gathered the stones on land near his farm roads and dropped them into the ruts, after breaking up the larger ones. He did not quite fill up the ruts. He also laid stones in the pad way, and drained away the water at every rill and watercourse. John Lawrence (1801) agreed with Mordaunt that all gateways, both public and private, should be paved with stones, or if no stone was to be had, with green elm, willow, sallow or other suitable wood, covered with well-rammed earth, to make an even and solid surface. (6)

The nuisance of trees in hedgerows at the side of the roads was remarked by all these writers, and, indeed, legislation was introduced providing that no hedge against a public road should be more than six feet high.

In the middle of the eighteenth century there were many tree-shaded avenues leading to houses. One of these, mentioned in a contemporary

publication, was half a mile long and led to a manor house which had been in the tenure of one family for nearly half a century. Yet not one occupier had ever thought of mending the wagon way of this avenue. They used it only when passable. At other times, they dragged their loaded wagons, with double teams, over the ploughed lands, making a fresh track every time they passed. This was hard work and quite uneconomic. When at last one member of the family decided to cut the elms bordering the avenue, his landlord would not agree, so the tenant cut ditches at each side of the avenue to drain it, and kept the road as a bridle way. He found the roots of the elms spread into the good land at least 2 rods on either side of the track, and on this land he built convex roads with a uniform surface and gutters to drain off the water. They were rolled with an iron roller to which a trough, carrying two tons of stones, had been added. These roads, he claimed, remained firm for about ten years. (7)

Opportunity for Improvement The progress of enclosure between 1760 and 1840 provided great opportunities for improving farm roads. Possibly one-third of the country was laid out differently and, as a result, sensible landlords were able to make roads in the most suitable line across their farm. When new fields were laid out, it was thought that the farm roads ought to be along the headlands, and the gates so placed that either side of the dividing hedge might be used.

Nearly everyone agreed that the road surface should be convex, though Bakewell of Dishley had made concave roads. "In effect, nothing more than a flat road with a gutter in the middle instead of a gutter at either side." Many farm roads were, in 1831, still metalled only in the wheel ruts and horse tracks, like those of Mordaunt's ingenious farmer. Loudon did not disapprove of this in dry, firm-bottomed land, but his general principles were that a farm road should not be less than 16 feet wide to allow two wagons to pass. It need be only half metalled, this part being used in winter and by loaded carriages. The turf road forming the other part served for summer, dry weather, empty wagons, or foot passengers. From the public highway to the farm, the road, he said, ought to be metalled in the middle with an earth road at each side. These metalled roads could be formed of stone or gravel, broken into small fragments and laid thick enough to take the weight of traffic after rolling flat. The surface had to be firm enough to resist the pushing action of the horse's feet and the wheels of carriages, which would otherwise quickly destroy the road. (8)

By this time, a great deal of theory about road building had been formulated. Most of the theorists disagreed with one another in minor details, and it is doubtful in any case whether their advice ever reached the farmer. Certainly little progress was made, and even the example of the turnpikes did not greatly affect parish roads. Some Midland villages were far from a metalled highway and, because of the state of other roads, little visiting took place after Michaelmas. By that time, too, winter stores of coal had to be in; later on loaded wagons could not get through. "The parish roads, where they were metalled, had in autumn a coat of pebbles from the field laid upon them; the largest only of the pebbles were cracked with a stone hammer." The turnpikes were made or mended with limestone or gravel, put on in autumn and scraped off as mud in winter (9). Many farm roads were still only 11 or 12 feet wide, so that a cart or wagon could only be passed by a horseman or foot passenger. If two vehicles met, one had to go back until a gate or wider space was reached.

By 1850, some of the old roads had often sunk beneath the level of the adjoining land. This was blamed on bad construction, but, in fact, it was

the effect of traffic wear and attrition caused by water. Such farm ways are not uncommon today; there are many sunken lanes all over the country, particularly in the South-West and in Surrey.

Foundations and Surfaces Emphasis continued to be laid by writers on adequate drainage. Bailey Denton, unlike Fitzherbert, wanted surface ditches on both sides, with pipe culverts where necessary, drains four feet deep and laid with 2-inch pipes communicating with the culverts, and drains crossing the road at every fence and hollow in the ground. He recommended the use of all the well-known materials for surfacing. (10)

The proper foundation of a farm road remained a matter of controversy, in spite of the marked agreement on most other points. John Donaldson was certain that if the surfacing material was put on turf, or a grassy surface with a good tough mat, it would resist the pressure of weighty traffic. It was a mistake, he maintained, to dig out the turf and make a trough. Indeed, he went so far as to suggest laying closely fitted turves as a foundation. If this was not possible, coarse earth, gravel, stone or chalk one inch deep and bound with gritty sand, would serve if rolled repeatedly in wet weather. He recommended that any ruts in this sort of road ought to be filled up at once, and drivers prevented from following the ruts by putting large stones in the way (11)—a rather Draconian procedure.

Dean did not share Donaldson's opinion, though he thought estate roads generally very badly constructed. He did not agree that surfacing material, however good, might be placed on a natural foundation. A solid base was essential. If clean, hard, broken stone was added it made the best roads; otherwise, the surface was greatly affected by changes in the weather. The stones moved, and the trampling of the horse's feet and rolling of the wheels disturbed them even more. The consequent friction wore them down into dust and mud, which only had to be scraped off. (12) This was also the great objection to a gravel surface, but did not apply to flint gravel if properly attended to. (13)

The 1880s Towards the end of the nineteenth century, R. Scott Burn published very elaborate instructions about road-making. He added little to what Bailey Denton had said twenty-five years before, though he thought a flat surface better than a concave or convex surface. Like Ward and Lock, he drew attention to the value of Portland cement concrete, which could be mixed by any farm worker, and dried quickly into a solid block of stone. He also advised good landlords to buy a horse-drawn road sweeping or cleaning machine. (15)

Much of this good advice may have been acted upon on the large estate roads, but it is doubtful if farmers were greatly impressed. They thought less elaborate methods would serve. One farmer, for example, used to make good roads by taking out the mould to a depth of 2½ feet. This trench he laid with faggots as closely as possible, and covered them with straw or brush to prevent the mould running through them. He then threw back the earth. This made a surprisingly good road. A Kentish farmer also used this method, but dug out only eight inches of soil. He added chalk foundry clinkers or the refuse of a brick kiln. (16)

Knowledge of how to make good farm roads was evidently widespread amongst our forefathers. Many useful, if not quite perfect roads were made; others were mere prepared tracks, which became almost impassable in bad weather. Better materials can be got today, but many of our gateways, for example, would make these old-time experts raise their eyebrows in horror.

Some of our badly-kept tracks would also astonish them, but the clean, durable roads which are to be found on many farms today would fill them with envy if they could return to see them.

References

1. GEORGE BOURNE. *The Wheelwright's Shop.* 1923, 18.
2. *The Book of Husbandry by Master Fitzherbert.* 1534. Ed. by W. SKEET. 1882. 81.
3. RICHARD BRADLEY. *A Complete Body of Husbandry.* 1727. 269, 279.
4. MATTHEW STEVENSON. *The Twelve Moneths.* 1660.
5. EDWARD LAWRENCE. *The Duty of a Steward to his Lord.* 1727. 80, 81.
6. JOHN MORDAUNT. *The Complete Steward.* 1761. 146-8. (JOHN LAWRENCE. *The Modern Land Steward.* 1801. 287-8. cf. WILLIAM MARSHALL. *The Rural Economy of Yorkshire.* 1788. I. 182-8, though he is mainly dealing with public roads, as were most of the writers who contributed to the Board of Agriculture's *Communications.* VI.)
7. *Museum Rusticum et Commerciale* 1762. II. 148-52.
8. J. C. LOUDON. *Cyclopaedia of Agriculture.* 2nd ed. 1831. 568-97. (cf. CHARLES PENFOLD. *Practical Treatise on Best Mode of Repairing Roads in British Husbandry.* 1840. III. PHILIP O. SKENE. *Roads in Baxter's Library of Agricultural and Horticultural Knowledge.* 3rd ed. 1836.)
9. *The Reminiscences of Albert Pell sometime M.P. for S. Leics.* Ed. by THOMAS MACKAY. 1908. 135, 162-6.
10. JOHN M. WILSON. *Rural Cyclopaedia.* 1849. VI. 55-62. J. C. MORTON. *Cyclopaedia of Agriculture.* 1856. 756-9. Farm Roads on Strong Soils. J. BAILEY DENTON. *J.R. agric. Soc.* 1857. 82-92. On Repairing Roads. W. G. CAVENDISH. *ibid.* 451-2.
11. JOHN DONALDSON. *British Agriculture.* 1860. 781-4.
12. G. A. DEAN. *The Culture, Management and Improvement of Landed Estates.* 1872. 199-204.
13. Roads and Highways. W. H. WHEELER. *J.R. agric Soc.* 1876. 397.
14. *Ward and Lock's Book of Farm Management.* c. 1880. 70.
15. R. SCOTT BURN. *The Practical Directory for the Improvement of Landed Property.* 1881. 151-65.
16. *Farm and Home.* Sept. 9, 1882. 333.

Lime and Fertilizer Subsidies

The Ministry of Agriculture, Fisheries and Food has closed its offices at Lytham St. Annes, Lancashire and transferred the work of paying the lime and fertilizer subsidies to its offices at Guildford, Surrey. Greater use will in future be made of mechanization, and the payable orders issued under the Fertilizers Scheme will be in a new form which is already familiar to farmers who receive fatstock deficiency payments.

The new address of the Agricultural Lime Department (U.K.), and of the Payments Unit (Fertilizers) is:

Government Buildings,
Epsom Road,
Guildford,
Surrey.

FARMING AFFAIRS

The Ministry in the Provinces Changes in the provincial and local organization of the Ministry of Agriculture, Fisheries and Food are foreshadowed by the decisions reached on some of the proposals made by the Wilson Committee in their recent report. The proposals so far examined relate to C.A.E.C.s, the setting up of Divisional Executive Offices, and the appointment of regional controllers. Many other important recommendations are still being considered.

In a written reply to a question in the House of Commons last month, Mr. Heathcote Amory said that the structure of the C.A.E.C.s would be unchanged although the number of sub-committees would be reduced. C.A.E.C.s would, however, be relieved of routine work connected with the administration of grants, subsidies, trading services, etc., although their local, practical knowledge would be fully used before decisions were made by officials on cases eligible for consideration. Broadly, the functions of C.A.E.C.s would be to supply local knowledge and to advise both the Minister and farmer; to promote technical development in conjunction with the N.A.A.S.; to exercise statutory functions relating to the Agriculture Act, 1947, the Agricultural Holdings Act, 1948, and certain aspects of the Milk and Dairies Regulations; and to give advice and guidance about local problems.

The recommendation that the executive work of the existing sixty county offices should be spread among a smaller number of divisional executive offices has also been accepted. This will mean that in some cases one divisional office will undertake the executive work of more than one county, but the most suitable combination of counties has yet to be worked out.

Farm and Forest: 18. Raising Stock from Seed The note last month dealt with the selection and preparation of a site for the small forest tree nursery. Having decided upon its situation, the potential grower can now get down to the details of raising his stock, assuming he does not propose to buy in seedlings to start his nursery.

In the first place, he will have to think about storing the seed he has collected to form the basis of his crop. Acorns may be stored, suitably separated, in moist sand in a well-drained pit two feet deep. The sides of the pit should be lined with $\frac{3}{4}$-inch mesh wire netting protruding six inches above ground, and a wire netting "lid" provided to keep out vermin. Stored acorns are normally sown in March. Beech mast may be treated in the same way. Ash seed should also be stored in the same manner immediately after collection, but it must be left until the *second* spring before sowing (again in March). Conifer seed is dry-stored and sowing should take place in early spring, from mid-March to the end of April. By sowing early, crops are more likely to become established before the spring droughts.

As mentioned last month, the nursery seedbeds should be $3\frac{1}{2}$ feet wide. Garden lines are then placed along the beds, 3 inches in from the sides, to give a sowing width of 3 feet. The seed is usually coated with red lead to help get a uniform distribution. (This coating has little value as a protection against mice, and is not necessary for large seed such as oak, ash and beech.) The seed should be broadcast over the surface of the bed and lightly pressed into the soil with a light wooden roller or narrow board fixed to a hoe handle. It is covered by riddling on grit which is free of lime and silt and preferably not more than $\frac{1}{4}$ inch in diameter. Germination is impeded when soil is

used as a covering on small seed, for the surface frequently becomes caked. Conifer seed should be covered to a depth of between $\frac{1}{8}$ and $\frac{1}{4}$ inch, according to the size of the seed, but large hardwood seeds (for example, acorns) may be planted much deeper.

Most spring-sown species take 3-4 weeks to germinate, and weeds may appear before the crop is visible. These can be destroyed by spraying with tractor vaporizing oil at 60 gallons per acre, provided no tree seedlings are showing. Further weeds should be removed by hand. It is not generally necessary to shade young seedlings in the first season, although cypress and western red cedar would benefit from shading in hot weather. Watering is rarely necessary with early sowing.

At the end of the first season, all seedlings over $1\frac{1}{2}$ inches in height can be lifted and transplanted; the smaller plants can be left in the bed for another year. Those moved to the transplant lines should spend one or two years there, depending on the conditions, until they are sturdy, well-balanced plants. In transplanting, the seedlings are set out in lines 8-10 inches apart, with 2-3 inches between the plants. A straight-backed trench is cut with a spade and the seedlings are packed against it by pushing a small amount of soil around the roots with the hand. More soil is added by forking over the ground, the plant is firmed by treading, and further forking and levelling follows until the ground is ready for the next line.

The use of transplanting boards (obtainable from nurserymen) is less tedious than hand laying and ensures a more uniform spacing within the lines. The seedlings should be transplanted immediately after lifting, preferably during calm conditions. Too much drying of roots can result in heavy losses; it is a good thing to pack seedlings upright in boxes lined with moist moss as they are lifted. Transplant boards should be filled behind a rough hessian shelter.

W. G. Gray,
Head Forester, Forestry Commission

Egg Marketing Scheme The draft scheme submitted last November by the United Kingdom National Farmers' Unions has been accepted by the Ministers concerned, subject to certain modifications. In announcing this, Mr. D. Heathcote Amory said that notice of the modifications was being sent to the promoters of the scheme. He did not think it appropriate to disclose the final conclusions until the promoters had had the opportunity of deciding whether or not to accept them.

It will be remembered that, in July, the commissioner who conducted the public inquiry into objections to the scheme reported in its favour. On the other hand, he accepted some of the objections to the original plan on the ground that producers' sales of eggs which had not been tested, graded and stamped would be too restricted. Accordingly, he made certain recommendations, the chief of which were: (a) that producers with not more than 50 (instead of 25) head of live poultry over six months old should be exempt from registration; (b) that all direct sales from producers to consumers, except, perhaps, sales to hotels and restaurants, should be covered by a licence which should not, however, require the producer to test, grade or mark his eggs; and (c) that sales by producers to retail shops should be permitted on conditions to be prescribed by the proposed marketing board.

Although the Ministers concerned have now accepted the scheme subject to modifications, as stated by Mr. Heathcote Amory, the modifications may not necessarily be those recommended by the commissioner. Unless the modified scheme is accepted by the promoters, it cannot go forward for the approval of Parliament.

Demonstration of Agricultural Machinery A unique opportunity for seeing all the leading British, as well as some foreign, tractors and equipment at work under farming conditions will be provided at Shillingford, Oxford, on October 10-12.

The demonstration area, totalling over 100 acres, has been divided into plots varying in size from 1 to 10 acres. Ground conditions are similar to those found on thousands of farms up and down the country. The products of most of the tractor manufacturers in this country, together with machines from America and the Continent, will be carrying out a wide and varied programme covering all types of ploughing, cultivating operations, ditch cleaning and trench digging, using implements supplied by the leading makers. At the request of a number of visitors from the East, two manufacturers will be demonstrating overhead irrigation (" artificial rain ") equipment.

Adding emphasis to the machinery demonstrations, will be an extensive " static " site, including 111 stands on which will be displayed all types of mechanical aids to farming.

All this should provide a worthy background to the World Ploughing Championship and British Championship Ploughing Match, which will be taking place on an adjacent site at the same time.

New Tests for Timber New, non-destructive methods of assessing the strength and quality of timber, based on techniques that have been successfully developed for other building materials, are being investigated at the Timber Development Association Research Laboratories. The advantage of such tests over the ordinary mechanical tests is that no damage whatsoever is caused, so that the same piece of wood may be used many times. This should be particularly valuable in tracing the progress of decay by insect or fungal attack.

The two main methods used both depend on inducing small vibrations in the timber, recording being done by electronic instruments. The " sonic resonance " test is best suited to testing rods and prisms, and articles where the length is considerably greater than the breadth. Sound waves are induced in the wood by a vibrator energized by an electrical oscillator. The frequency or pitch of the sound waves may be varied until a note is found at which the specimen resonates, or vibrates most violently. The frequency of the sound at resonance is determined by the dimensions, density and elasticity of the timber. The density may be found by weighing, so that with known dimensions the elastic properties may be calculated. Apart from the value of this knowledge generally to designers and research workers, changes in elasticity in any one species reflect changes in strength.

The " ultrasonic " test is more adaptable, since the size and shape of timber to be tested is not important. The vibrations induced in the timber are at a very high frequency—about fifteen times that of the highest note audible to the human ear. Ultrasonic waves have one extremely useful property, in that they can be focused into a fairly narrow beam. The instrument used in the test has two probes, which are placed on the timber a known distance apart. One probe transmits the ultrasonic waves as an interrupted sequence of pulses and the second probe receives them. The recording instrument is not unlike a clock, measuring the time taken by the waves to pass from probe to probe to an accuracy of a fraction of one millionth of a second. The time taken depends on the density and elasticity, and, indirectly, upon the strength of the timber. A crack or flaw in the timber lengthens the path of the waves and increases the time interval. The apparatus is self-contained and reasonably portable, so that it may be possible to test not only standing timber, but timber which is already part of a structure.

IN BRIEF

Sprouting of Potatoes Controlled by Alcohol Vapour

The possibility of using certain gases and vapours for suppressing the sprouting of potatoes has recently been investigated at the Ditton Laboratory of the Department of Scientific and Industrial Research. It was shown as long ago as 1932 that ethyl alcohol vapour would retard sprout growth, and work in 1952 had confirmed the efficacy of *n*-amyl alcohol. As the result of these latest trials, which took place in the main on two well-known varieties —Dr. McIntosh and Majestic—it seems probable that all alcohol vapours will retard sprout growth. Nonyl alcohol, in particular, shows promise of being applicable on a commercial scale.

A growth-inhibiting vapour would have many advantages over the common suppressant dust. In particular, application could be delayed until there were signs of sprouting, and the farmer would not have to decide whether or not to use a suppressant until some time after harvest, when he would be better placed to know whether he is likely to have to store his potatoes late.

Feeding Milk to Calves in Transit

No milk, except reconstituted dried milk, may be fed to calves in transit. This regulation,* which came into force on August 13, has been made to guard against the risk of spreading foot-and-mouth disease by feeding calves with raw milk which might have been infected. Attention was directed to the possibility of spreading the disease in this way by the Gowers Committee on Foot-and-Mouth Disease.

Survey of Agricultural Rents

The Department of Estate Management of the University of Cambridge is to make a survey of agricultural rents in England and Wales, the results of which should be of value to all connected with the agricultural industry. The request for the survey was made by the Chartered Auctioneers' and Estate Agents' Institute, the Country Landowners' Association, the Land Agents' Society, the National Farmers' Union, the Royal Institution of Chartered Surveyors and the Ministry of Agriculture, Fisheries and Food.

Owners and agents of a representative sample of 35,000 holdings will be asked to answer questions about acreage and type of holding, present and past rents, method of determining the rent, and the reason for changes. The survey is expected to take eighteen months and the Department of Estate Management intends to publish the results.

Potato Yields

Trials at the Nottingham University Farm to investigate the reasons for wide variations of the yield of individual potato plants in a healthy and apparently uniform crop confirmed the desirability of wider spacing with the variety King Edward. But wider spacing of Majestic led to a high proportion of coarse and cracked tubers. The depth of planting was found to have

* The Calves (Feeding in Transit) Order, 1956 (S.I.1956/1127). H.M. Stationery Office, price 3*d*. (5*d*. by post).

a great effect on the number of tubers; generally, the more shallow plantings gave the highest figures. Sprouted seed outyielded non-sprouted by 33 per cent, while the effects of "weathered" and "acclimatized" seed were not reflected in differences of yield. In a small-scale trial, tubers planted with the rose-end downwards yielded between 14 and 19 per cent less than those planted upright. This result was associated with delayed emergence of plants from the tubers planted rose-end downwards.

A not unexpected general association between seed size, stem number and tuber yield had been observed in earlier trials. There was also a strong indication that early emergence of the crop is advantageous. There was, however, no evidence of hereditary differences in yielding potential between individual plants.

Cereals Deficiency Payments Scheme to Stay

The present system of guaranteeing home-grown cereals by deficiency payments is to continue as a permanent arrangement. No change in the method of financing the payments from the Exchequer, or in the detailed administration of the system, is at present proposed by the government. Announcing this in the House of Commons on August 2, Mr. Heathcote Amory said that the scheme, which had been introduced for the 1954 harvest and had since been run successfully for two years, had been most effective in implementing the government guarantee while preserving all the advantages of a free market in grain.

Since 1940, the pre-war legislation for deficiency payments on wheat and for subsidies on oats and barley has been suspended. The decision to put the present scheme on a permanent footing will mean the repeal of the legislation and the disbandment of the Wheat Commission which administered the payments on wheat before the war. The Commission was set up under the Wheat Act, 1932.

Cheese Publicity

The English Country Cheese Council, which was formed last September with the object of reawakening public and trade interest in our traditional English cheeses, has now started publishing a bulletin named *English Cheese*. It is hoped that eventually this bulletin, which gives news and practical information on all aspects of the trade, will be issued free to every grocer throughout the country.

The Council's sales promotion campaign seems to be producing results. From January to May this year the cheese industry received 95 million gallons of milk (compared with 68 million gallons last year) and production of all English varieties increased by 10,000 tons, or 42 per cent. Cheddar and Cheshire, now totalling some 81 per cent of the market, made a considerable contribution towards this increase, but the outstanding progress was made by some of the lesser known varieties, such as Double Gloucester (140 per cent increase) and Leicester (231 per cent).

Productivity Committee to help Northern Farmers

Hull Productivity Committee, which has been running an advisory service for local manufacturing firms since January, is now preparing to extend it to farmers.

This decision was taken as a result of the great interest shown by farmers

in all aspects of productivity when the Hull Committee had a stand at the Great Yorkshire Show at Harrogate. In the three days some 2,300 enquiries were dealt with.

Work study and its application to farm tasks proved to be the farmers' predominant interest, but the inquiries covered a wide range of productivity techniques, including office organization, and mechanization. As a result of all this, a panel of four skilled farmers is being added to the Committee's existing industrial panel to deal with strictly agricultural problems.

S S S

Electing a New Head for F.A.O.

A special session of the 72-nation Conference of the Food and Agriculture Organization (F.A.O.) will be held in Rome on September 17 to select a new Director-General. Ill-health caused the resignation of the former Director-General, Dr. P. V. Cardon of the United States, three months ago. The constitution of F.A.O. specifies that only the full conference of member nations may elect a Director-General.

S S S

International Action on Warble Fly

As part of its programme for the improvement of animal health control in Western Europe, the European Productivity Agency of O.E.E.C. recently called a number of experts together to consider more effective means of combating Warble fly. The meeting was attended by some 35 representatives from Belgium, France, Germany, Ireland, Luxemburg, the Netherlands, Switzerland and the United Kingdom, and included those responsible for the technical or administrative control of Warble fly infestation, and representatives of the hides and skins industry, agricultural advisory and veterinary services, and farmers' organizations.

The purpose of the conference was to enable all those actively concerned with the control of this pest to discuss their experiences and to co-ordinate their future work, including enforcement and research. The main aspects considered were the incidence and economic effects of Warble fly infestation, practical methods of control and their application, control regulations and their enforcement, and publicity and education.

It was agreed that there was a need for unified research programmes aimed at the discovery of a therapeutic agent which could be applied before the appearance of the warbles on the animals' backs, and the hope was expressed that the leather industry would continue to give its support to research work in this field. It was recommended that the exchange of experience and co-ordination of research should be stimulated on the international level by enabling research workers to meet regularly. With regard to control regulations and their enforcement, it was stressed that the active co-operation of farmers was indispensable, and the meeting put forward a suggestion that there should be border zones of protection next to countries in which the control of the Warble fly is systematically organized. It was recommended that collective treatment of animals should be enforced in those zones to avoid reinfestation in the neighbouring countries.

BOOK REVIEWS

Food: Vol. II. Studies in Administration and Control. (History of the Second World War). R. J. HAMMOND. H.M. Stationery Office and Longmans. 50*s*.

In his second volume (the first was published in 1951) Mr. Hammond offers a collection of detailed monographs on war-time food control. They fall, broadly, into three groups. One deals with " emergency services " devised by the Ministry of Food to meet the menaces of air attack and invasion; with the effects of air raids on distribution, and with the growth and decline of the British Restaurant and other forms of communal feeding which were inextricably part of emergency arrangements.

A second group, occupying nearly half the book, tells the complicated story of the rationing system, tracing it back to the controversies of 1917 which conjured up that familiar figure, the registered customer. It shows how the rationing machinery of 1940, a close copy (although with some misunderstandings) of that of 1918, was adapted through trial, error and ingenuity to different circumstances. The description is necessarily detailed and much of it is, in the main, for the specialist in administration. Yet it raises questions of greater import. Were the principles of the rationing system and, particularly, the consumer-retailer tie, really suitable for " total " war? By implication, would not something more flexible be needed another time? Mr. Hammond's final chapter briefly discusses these questions. He offers no easy solution but much opportunity for thought.

Readers of *Agriculture* may find most to interest them in the first part of the book, which describes the Ministry of Food's dealings with the four mainly home-produced commodities—fish, eggs, poultry and milk. Before the war, none of these foods had been subjected to fully planned control, nor, with the exception of milk in England and Wales, were they ever Ministry owned The Government's approach to them was tentative (except for fish, where it was precipitate and, therefore, at first, disastrous) and control developed slowly. The accounts here given tell the story of each, with the economic, political, administrative and legal difficulties which reared themselves against simple, clear-cut solutions to the problem of control. One is made aware of the limitations on Departmental action even in war-time. Fresh light is thrown on controversies old and new; the vexed question of milk distribution costs and the possibilities of effective egg marketing control, to take but two examples. Some cherished assumptions of food policy are questioned. Was the Ministry of Food wise, for example, to press for so large an acreage of potatoes?

Though long, the book is closely argued and demands attentive reading. This is helped, however, by the sustained vigour of the style and by its scholarship. There should be many readers who will look forward with keen interest to Mr. Hammond's third volume in this series.

E.St.J.H.

595.771
V602 X
1946-

Gall Midges of Economic Importance. VII: Gall Midges of Cereal Crops. H. F. BARNES. Crosby Lockwood. 21*s*.

This is the penultimate volume in a series started in 1945, and it virtually completes the work on crop plants. The final volume will deal with gall midges living on other animals, weeds and fungi, together with Addenda and Corrigenda to Volumes I-VII.

In his Preface to Vol. I, Dr. Barnes said: " It is believed that the present work will serve its primary purpose of making readily available what is known concerning the gall midges of economic importance throughout the world." I have had frequent occasion to consult these books, and I believe that the author has fully justified his belief. In a brief review it is impossible to do full justice to the work, but Dr. Barnes must be congratulated on his approach to pest diagnosis. He places most emphasis on special characteristics of the insect or the damage it causes, avoiding detailed morphological descriptions. This is just the approach that appeals to the field worker who may not have a specialist at his beck and call, but who must find a fairly quick and reasonably accurate answer to his problems.

This volume is perhaps the most important of the series, if judged by the destructiveness of several of the midges dealt with. The Hessian fly, for example, is troublesome in Europe and other parts of the world, but following its introduction to N. America, it became about their most important pest of wheat. To the entomologist this is a fascinating story and Dr. Barnes tells it well. Space does not allow reference to many more examples, but readers will find of great interest the accounts of Wheat Blossom and Sorghum midges.

Although the title suggests that this series will appeal only to the economic entomologist, it contains much of interest to the agrarian and general reader, and the series should certainly be available in all agricultural libraries. The publishers are to be complimented on the uniformly high standard of production of these volumes and their very reasonable price.

F.H.J.

TE 2a
316 1955-

Modern Methods of Plant Analysis. (4 Volumes). Edited by K. PAECH and M. V. TRACEY. Springer-Verlag, Berlin. DM 501,–.

This work was undertaken to meet the need for a collection of reliable, up-to-date methods for plant analysis and to take the place of Klein's admirable, but now outdated *Handbuch der Pflanzenanalyse*. Its scope may be judged from the fact that it contains 69 sections which together amount to almost 2,700 pages and include over 400 figures. It represents the collected efforts of sixty-eight authors, and the names of the contributors are, in themselves, an indication of the authority this work must command, since many of them are rightly recognized as experts in the fields they discuss. The editors have arranged the subject matter very suitably in four volumes which can be purchased separately. About two-thirds of the articles are in English, the remainder are in German.

Volume I (DM 108,–) provides the foundation for the whole work, being primarily concerned with methods of analysis that are of general application and are consequently frequently referred to in the subsequent volumes. For example, it includes sections on the handling and fractionation of plant materials, chromatographic techniques, optical methods of analysis, the determination of pH and of oxidation-reduction potentials in plant extracts, techniques involving the use of labelled atoms, and methods for gas and ash analysis. This volume is perhaps the most generally useful of the four as it contains much that is of value for all concerned with the analysis of plant materials. Seven of the seventeen sections in this volume are in German.

Volume 2 (DM 110,–) should be of special interest to those concerned with plant carbohydrates, as it deals with methods of analysis for the following substances: mono- and oligo-saccharides; starch, glycogen, fructosans and similar polysaccharides; cellulose and hemicelluloses; pectin; glycosides; plant gums and mucilages; ascorbic acid; chitin; phosphorylated sugars; and acyclic sugar alcohols. It also contains sections on volatile and non-volatile acids, inositol and related compounds, lactones, and fats and other lipids. Four of the seventeen sections in this volume are in German.

Volume 3 (DM 138,–) is largely devoted to methods for the estimation of the so-called secondary plant products, a group that includes many substances of commercial importance occurring only in plants. For example, it deals with terpenes, carotenoids, quinones, lignans, natural tropolones and phenylpropane derivatives, pyrethrins and allied compounds, rubber and gutta, flavonoid compounds, tannins and lignin. It also contains very comprehensive sections on plant growth substances and antibiotics. The editors regard this volume as the corner stone of the whole work, and there seems little doubt that it will be found invaluable in many laboratories, as it deals with a group of substances that are currently receiving a great deal of attention. Seven of the seventeen sections in this volume are in German.

Volume 4 (DM 145,–) is concerned with the estimation of the nitrogenous plant constituents. It should be particularly valuable to those interested in nutrition, since it deals with substances that affect the value of plants as foods and contains a discussion of the merits of different methods of determining feeding value. The following are among the subjects discussed: proteins; peptides and free amino-acids; chlorophylls; haematin compounds; nucleic acids; alkaloids; adenosine di- and tri-phosphates; co-enzymes I and II; thiamine and its derivatives; melanins; sulphur-containing oils; cyanogenetic compounds; members of the B group of vitamins; urea and ureides. Pharmacologists should appreciate the very thorough treatment afforded the alkaloids, and the section on urea and ureides is noteworthy in that it draws attention to a group of substances that clearly has not received the attention it deserves. Five of the eighteen sections in this volume are in German.

This work fills a long-felt want and should prove indispensable to any laboratory concerned with the analysis of plant materials. Its value will be enhanced if the editors can fulfil their intention to issue supplementary volumes to make further advances in plant analysis accessible. It is unfortunate that the many admirable sections in the work cannot be purchased separately, for the price of the entire work (about £43) is beyond the reach of most individual workers.

J.M.B.

BOOK REVIEWS

First Aid on the Farm. GEOFFREY P. WEST. A. and C. Black. 12*s.* 6*d.*

The principal part of this attractive little text-book describes the common, and some uncommon, diseases of cattle, pigs and sheep, together with very brief notes on the care of farm cats and dogs. The remainder consists of short chapters on first aid, what the author terms "marginal" health, hints for good health, sources of infection and resistance to infection, poisoning in farm animals, trace elements, vitamins, the inhabitants of the rumen and the importance of fibre. In addition, there are twelve diagrams, including a coloured one of the cow which gives a clear, visual impression of the whereabouts of the organs under the skin. There is no glossary or index, but the specific diseases are dealt with in alphabetical order.

Writing veterinary texts for the layman is a difficult art full of pitfalls, and it can be said at once that the author has acquitted himself creditably. The sections on diseases of farm animals contain accurate, concise and up-to-date information which should prove very useful to stockmen. There are few misprints and inaccuracies, but attention may be called to the statement on page 116 that contagious pustular dermatitis vaccine is not safe for lambs. This is incorrect. The vaccine is intended for lambs and has been widely used on these animals; it is perfectly safe but not always perfectly effective. But what is?

First aid means giving medical or surgical treatment pending the arrival of the doctor or veterinary surgeon, and, accordingly, a more extended account of common mishaps among farm animals might have been given. Also, it would have been more convenient for the reader had all the information on poisoning been gathered into one chapter, and the stock owner should have been strongly advised to call for professional advice immediately poisoning is suspected. I cavil at the recommendation that potassium ferrocyanide can be used as an antidote to copper poisoning. In the hands of the layman such a cure is likely to prove worse than the disease. What is wrong with potassium permanganate?

Here and there a little obscurity mars the text. Thus we learn that peanut oil has been used as a first aid measure in bloat. Is this really used to knead the swelling? Again, we are told that tuberculosis is not common in cats, but that neither is it rare. Presumably the author means that this disease sometimes occurs in cats.

The book can be recommended as a handy tutorial for the student, and will provide excellent reading for the stockman (for whom a glossary of technical terms would have been useful). It is a pity that more mention is not made of the three cardinal points for the prevention of animal disease—namely, isolation, quarantine and disinfection.

W.L.S.

TE2
721
X

Organic Insecticides: Their Chemistry and Mode of Action. ROBERT L. METCALF. Interscience. 68*s.*

The introduction of DDT some fourteen years ago was quickly followed by the development of many more chemicals for the control of pests affecting man, animals and plants. Of the newer materials, special mention may be made of the insecticides *gamma*-BHC, aldrin, dieldrin, parathion, schradan, and demeton, and of the acaricides chlorbenside and chlorfenson. The advent of these chemicals, which have supplemented the pre-war nicotine, derris, pyrethrum, dinitrophenol and thiocyanate preparations, has resulted in an unprecedented increase in the use of pest control measures whose value is fully appreciated by health workers and growers throughout the world.

The introduction of the chemicals has been accompanied by biochemical research of high standing on the relationships between the chemical structures of compounds and their toxicities to insects, on the mechanisms by which the chemicals exert their toxic effects, and on the factors underlying the development of resistance by insects. In this research Dr. Metcalf, who is entomologist at the University of California Citrus Experiment Station, has played a conspicuous part. His book, which is an extension of his earlier invaluable monograph *The Mode of Action of Organic Insecticides*, brings together and discusses in detail the very considerable volume of work that has been carried out on the chemistry, the metabolism in plants, and the mammalian and insect toxicology of the modern organic insecticides of both synthetic and botanical origin.

The book is beautifully produced and contains many references. It is intended essentially for the specialist worker and does not set out to give recommendations on the use of the materials. It will be given a very warm welcome by research workers and advanced students and by persons concerned with toxicological problems arising in pest control work.

J.T.M.

The Pocket Guide to Wild Flowers. DAVID MCCLINTOCK and R. S. R. FITTER. Collins. 25*s.*

These two authors, with the assistance of Dr. Francis Rose, have set out to provide a non-technical, easy-to-follow guide for the country-lover, and they have almost achieved their aim. They have reduced the usual rather wearisome botanical introduction to a mere six pages of necessary explanation and then plunged right in with the descriptions of plants. Beginning with the buttercup family, they cover marsh marigold, globe flower, stinking hellebore, green hellebore, winter aconite and monkshood on one page, so succinct are the descriptions and notes on distribution.

But the reader is not expected to use the book by painfully studying the botanical details of the flower. He need only note its colour and, turning to the 64 plates, run through them until the appropriate flower colour and leaf form catch his eye. Then all he has to do is to note the flower's name and reference number and turn it up in its numerical sequence.

Suppose, for example, you are a casual visitor at, say, Dungeness, and you see growing in the shingle a large yellow four-petalled flower with blue-green foliage, spiny buds and long curving seed vessel. In Plate 38 you will find it depicted unmistakably and called "the yellow horned poppy", with a reference number 41. Turning to No. 41 you will find just the details you need to be fairly certain of your plant.

If, on the other hand, you are an agricultural student walking over a Severn-side pasture and you notice an unfamiliar, medium-sized, whitish-pink clover, you may have more difficulty. Its slightly inflated calyx may attract your attention. You try in turn the illustrations of the clovers, the yellow, pea-like flowers on Plates 47-49, the red clovers and alsike, without success. The illustration of strawberry clover, when you eventually trace it, is not very convincing and, in fact, it is on some of these smaller and borderline flowers that the coloured plates let you down. The larger and more showy flowers are excellent but the smaller and less conspicuous are difficult to portray at any time. Thus heart's-ease, the smaller species of speedwell and toadflax, and golden saxifrage are not very successful. The black-and-white illustrations are bold, clear and generally good.

Experienced readers, interested in the old names of plants, will question the validity of introducing ungracious names like "Beef-steak plant" when Gerard's name "Gladden" or "Gladwin" has served us well since the sixteenth century, and question an upstart name like "Mind-your-own-business" being preferred to "Mother-of thousands", which does give a clue to the plant's prolificacy. But these are quite minor details. The book will appeal to most country-goers as convenient for rucksack or pocket, and by its means a good basic knowledge of British wild flowers can be acquired.

H.W.M.

"What Wood is That?" DR. ALFRED SCHWANKL (Translated by H. L. EDLIN). Thames and Hudson. 25*s.*

There is a good deal of information in this book which Mr. Edlin has translated so well that there is no trace whatever of that "foreign aspect" which the author says certain woods from overseas possess and by which he invites us to identify them. However, the choice of tropical woods includes both ebony and mahogany which, far from looking foreign to us, evoke memories of our grandparents' drawing room. Indeed they are more homely to many of us than some British species, which are familiar enough in the forest but whose wood is rarely seen in present-day homes or in farm furniture. Critics may cavil at the choice of woods identified and described, but the author is entitled to his own choice. Most of the common trees in the author's homeland are also old friends in the British countryside.

As its title implies, the book is a guide to the identification of certain woods, but within its stiff covers are found not merely printed pages but ten plates each carrying four specimen strips of timber. In addition, a well-produced booklet is tucked into the other flap. The trees chosen are very well described and identified by the key supplied, although it takes a little trouble to understand exactly how to use it.

The first part of the book clearly describes the way wood grows, how fast and slow growing timber can be recognized from examination of the surface and, finally, the effect of different methods of sawing on the appearance of the timber.

The book is not, and does not pretend to be, exhaustive, but within the author's self-imposed limits it is interesting in its content and novel in its presentation.

R.G.A.L.

Gower. (Regional Book Series). OLIVE PHILLIPS. Hale. 18*s*.

Many will disagree with the boundaries accepted for this Regional Book. Gower has unfortunately come to be regarded in many quarters simply as the Gower Peninsula, and, to judge from some of the references, that certainly seems to be the case in this book, particularly in the introduction. The author has, however, justified herself by taking the East Gower as well as the West Gower into this work.

Miss Phillips does not claim to be a specialist; rather can she enjoy " the infinite variety of Gower from its flowers and its birds, to its cockles and its castles ". Her book well achieves her attempt to convey this variety. It also gives a clear impression of the differences between the various areas inside the region, and leaves the reader with the satisfaction of having visited them in the company of someone who obviously knows the whole district well.

The book contains a lot of historical information as well as detail about the growth and development of local industry. Little is said of the agricultural interest, presumably because there is so much else to be discussed. But would it not have been better to have confined the work to a smaller area and to give a more detailed picture? The concluding chapter on natural history does, however, compensate appreciably for the agricultural deficiency. The index proved to be thorough and helpful under test.

Anyone who has a knowledge of, or who is interested in, this particular part of Glamorgan will find the book well worth reading.

J.D.

Three Year Summary of the Broccoli Investigation in West Cornwall, 1952-55. HELEN M. COLE. University of Bristol, Department of Economics Report No. 89. 1*s*. 6*d*.

The lack of economic and statistical data relating to the horticultural industry is generally deplored; this report will be warmly welcomed for the gap that it helps to fill. Average costs, returns, margins and yields are summarized from the information supplied by growers who co-operated in the scheme. These are particularly interesting in showing how costs are distributed between the various processes of growing and marketing, even though the range attributable to different methods and circumstances are not detailed. The high price per pack in a season of poor yield is more to be expected than the better gross returns in a " good " year, suggesting that broccoli sells on quality rather than scarcity value.

Costing methods are given in the report to explain the treatment adopted for the vexed questions of overheads, manurial and cultural residues. These also serve to show the complexity of costing an individual crop which forms only part of the production system on a holding. Notes are included on the features of the seasons under review and on some current problems but, in general, the author has refrained from comment and offers the bare facts and figures for the study they well deserve.

The report is obtainable from the Department of Economics at 1 Courtenay Park, Newton Abbot, Devon.

K.H.J.

"AGRICULTURE"

Price 9d. net monthly, post free. (Foreign countries, 11d. post free).

Subscription Rates (including postage):

Inland and Imperial ... ... 9s. per annum
Foreign Countries ... ... 11s. per annum

Subscription may start with any issue and should be sent to

H.M. STATIONERY OFFICE

York House, Kingsway, LONDON, W.C.2 — 423 Oxford Street, LONDON, W.1
P.O. Box 569, LONDON, S.E.1
13a Castle Street, EDINBURGH, 2 — 109 St. Mary Street, CARDIFF
80 King Street, MANCHESTER, 2 — 1 Tower Lane, BRISTOL, 1
2 Edmund Street, BIRMINGHAM, 3 — 80 Chichester Street, BELFAST

Single copies can be purchased from any of the above-mentioned addresses or through a bookseller

Printed in Great Britain under the authority of HER MAJESTY'S STATIONERY OFFICE
by Billing and Sons Limited, Guildford and London.

Customer: Mr. S. C. Dicker, Vernons Farm, Henham, Bishops Stortford
Breeds: Essex, L.W., Landrace

SILCOCKS

Proof of the feeding

Two years ago Mr. Dicker could not make his bacon unit pay, although top grade bacon was up to 55/6d. per score. Then he changed to Silcocks and called in the Silcock Advisory Service to overhaul his methods and plant.

To-day, although grading is tighter and the price is lower, the 600 pigs he sends to the factory each year are showing a handsome margin.

In the last twelve months his 40 sows averaged 9.2 reared, at a weaning weight of 41.4 lb. His baconers now go to the factory at six months at around 210 lb.

Grading? Of the last 100 sent to the factory, 96 graded "A" or "AAA".

R. Silcock & Sons Ltd., Stanley Hall, Edmund Street, Liverpool, 3

BY APPOINTMENT SEEDSMEN TO THE LATE KING GEORGE VI

FOR MAXIMUM YIELDS IN 1957

Webbs'

TRUE PEDIGREE SEEDS AND HIGH GRADE FERTILISERS

Our Autumn Catalogue lists **TRIALLED** and **PROVEN** varieties suitable for all climatic and soil conditions and all levels of soil fertility.

Our Representatives or Head Office Staff will gladly advise on the choice of a suitable variety.

Information and Catalogues from

EDWARD WEBB & SONS (Stourbridge) LTD.
2 WORDSLEY STOURBRIDGE WORCS.

MANGANESE / *an essential element*

MANGANISED COMPOUND FOODS

The *complete diet* of poultry should contain from 50 to 55 p.p.m. of manganese (Mn). Less is known about the desirable levels of manganese in the rations of other kinds of farm animals. From 20 to 40 p.p.m. would generally prove sufficient in complete diet compounds for pigs, while the level for ruminants has been put at 20 to 30 p.p.m. Some generosity in the use of supplementary manganese will do no harm and will serve to offset the effects of any factor, e.g. excessive intake of calcium, which would tend to inactivate some of the manganese present.

ANIMALS MUST HAVE MANGANESE

Information and literature may be obtained from our Agricultural Department.

CHEMICAL & CARBON PRODUCTS LTD.
14J NEW BURLINGTON STREET LONDON W1

Boulders to beef...the span is wide in the September issue of

The Agricultural Review

Agriculture is many subjects and today all are specialised. THE AGRICULTURAL REVIEW, with its expert specialist writers and its 'whole view' of the agricultural scene, presents authoritatively the latest scientific developments to help the modern (and busy) farmer keep up-to-date.

Land reclamation is to be the subject of a series of articles. The first, appearing in this issue, is by H. Burr, County Agricultural Officer for Cornwall, and deals with the technique and cost of *reclaiming boulder-strewn land.*

With beef returns well below those of the 'boom' of 1955 a re-examination of the position is due. W. Harwood Long, Provincial Agricultural Economist, Leeds University, writes on *The Economics of Beef Production.*

For poultrymen, Dr. R. Coles discusses the Ministry of Agriculture's *plan for progeny testing of laying birds* and considers some of the criticisms of the scheme in relation to the arguments on which the existing proposals are based.

Those interested in *crop irrigation* will find much useful information in the article by E. R. Hoare, Head of the Horticultural Engineering Department, National Institute of Agricultural Engineering; it covers the economic use of irrigation equipment, layout, cost and application.

The testing of new cereal varieties never ceases—C. C. V. Batts, National Institute of Agricultural Botany, describes the methods used for testing resistance to yellow rust fungus and loose smut.

The Abstracts this month include reports of conferences held by the Nutrition Society at Reading and by Plant Breeders at Cambridge. There are many other articles in addition to those summarised as well as the book reviews, a comprehensive economic review prepared by the Economist Intelligence Unit and other regular features. The September Agricultural Review is now on sale.

Read the Agricultural Review every month. A yearly subscription is 30/- post free. Write to:

The Subscription Branch, Hulton Press Ltd., Long Lane, Liverpool 9.

Or you can place a regular order with your newsagent (2/6 an issue).

PAULS for preference

By Appointment to H M. Queen Elizabeth II Manufacturers of Animal Feeding Stuffs

The sign of scientific feeding

The feeding of your cattle starts with the cereals and roots you grow yourself. But it doesn't by any means end there –not if you want to rear prize cattle and milking herds.

It must be scientifically supplemented by a diet that adds all the essential balanced nutrients, minerals, and vitamins animals must have if they are to be really magnificent 'good doers'. Pauls Quality Cattle Foods provide *all* these: made to the latest scientific formulae in the most modern mills.

Pauls Coarse Dairy Ration • Pauls Dairy Ration Nuts/Meal
Pauls Special High Yield Dairy Ration Nuts/Meal

***For milk production—Feed* PAULS**

R. & W. PAUL LIMITED

You *should*

bank with the

Westminster

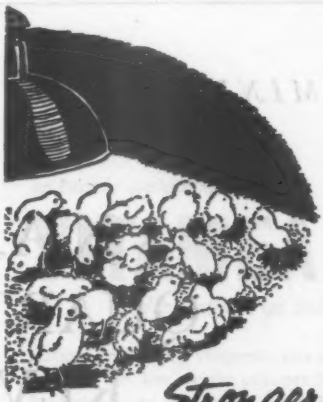
Westminster Bank Limited
Head Office: 41 Lothbury
London, E.C.2

TURNEYS

ENGLAND'S BEST CHICKS

THE "STANDARD"
SET BY

TURNEY BROS.
QUINTON GREEN, NORTHAMPTON
TELEPHONE: ROADE 220



Stronger and faster growth-

with Philips Infra-red Heating Units

Rearing is *bound* to be much more profitable when you use Philips Infra-Red Heating Units, for this inexpensive Philips equipment prevents losses from over-laying or from cold and damp. And because the maximum amount of food is used for growth instead of maintaining body-warmth, pigs reach bacon-size weeks earlier than usual.

Philips Infra-Red Heating is equally successful with chicks. Under its beneficial warmth, they move about freely, develop without setbacks, and because they get maximum value from food, they too grow faster — and healthier and hardier into the bargain.

Full information is given in the free booklet "Livestock Rearing with Philips Infra-Red Heating". Write for your copy *now*! You'll be particularly interested in model DUC/250, which costs only 85/9d.

PHILIPS ELECTRICAL LTD.

Philips Electrical Ltd · Lighting Division (SLD)
Shaftesbury Avenue · London W.C.2

LAMPS · LIGHTING · 'PHOTOFLUX' · FLASHBULBS
RADIO · TELEVISION · 'PHILISHAVE' DRY SHAVERS · ETC.

MINISTRY OF AGRICULTURE, FISHERIES AND FOOD

N.A.A.S. QUARTERLY REVIEW

The Journal of the National Agricultural Advisory Service

Review articles and abstracts on:

Animal Health, Animal Breeding, Animal Nutrition, Soils, Herbage, Crop Husbandry, Fruit, Machinery, Glasshouse Crops, Flowers, Soilless Culture, Nutrition of Horticultural Crops, Vegetable Crops, Plant Breeding, Dairy Bacteriology, Dairy Husbandry, Poultry Husbandry, Entomology, Mycology, Virology.

Published March, June, September, December

Price 1s. 6d. (1s. 8d. by post)
Yearly subscription 6s. 6d. (including postage)

from

HER MAJESTY'S STATIONERY OFFICE

at the addresses on page 302
or through any bookseller

Save yourself

$I\frac{1}{2}$

tons of food

rearing a litter of 8

INSIST

on rations containing

VITAMEALO

for Cattle, Pigs and Poultry

Rations containing Vitamealo can and do produce 1lb. live weight gain per 3lbs food consumed. In feeding for milk and egg production, specially formulated rations containing Vitamealo provide similar economies in food costs.

• *Ask your local merchant for delivered-in prices of rations containing Vitamealo or write for further particulars to Dept. C.5*

AGRICULTURAL FOOD PRODUCTS LTD., UPPER MALL, LONDON, W.6.

Branches at SALTNEY, CHESTER AND KEYNSHAM, BRISTOL

"PERMANIZED" VITAMINS A AND D3 MADE SOLELY BY OUR ASSOCIATED COMPANY VITAMINS LTD., ARE USED IN VITAMEALO PRODUCTS

Where your money does its job ---

—and brings you a full

4% TAX FREE

Equal to £6.19.2 PER CENT GROSS

STATE BUILDING SOCIETY

MAXIMUM SECURITY

★ Easy withdrawals
★ Income tax borne by the Society
★ Any amount accepted up to £5,000
★ No depreciation

25 years of progressive expansion

JUNE 1931 — JUNE 1956
ASSETS NOW EXCEED £4,000,000

Full particulars from the Secretary:

STATE BUILDING SOCIETY
47 State House, 26 Upper Brook Street, Park Lane, London, W.1.
Tel: MAYfair 8161

By Appointment to H. M. The Queen
Seedsmen

DUNNS FARM SEEDS LTD.

Scientific Adviser:
SIR R. GEORGE STAPLEDON, C.B.E.

BETTER GRASSLAND?

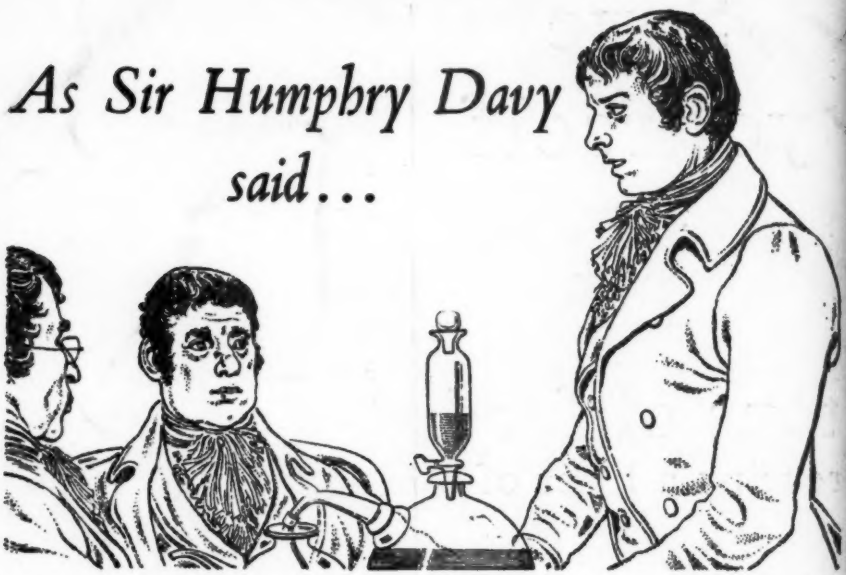
BETTER CONTACT DUNNS!

Farmers throughout the country know that the consistent quality of our grass and clover seed mixtures springs from our insistence on certified strains, backed by many years of scientific trial. Our Technical Advisory Service enables farmers everywhere to get the best from the best of seeds. We will be glad to visit you and to recommend the mixture for *your* special needs. If you want the best grassland, there are no better seeds and no better service.

DUNNS FARM SEEDS LTD • SALISBURY

Telegrams: Dunnseed, Salisbury
Telephone: Salisbury 3247-8-9

As Sir Humphry Davy said...



BEFORE 1802, few people associated chemistry with agriculture. In that year Sir Humphry Davy began a series of lectures for the Board of Agriculture, in one of which he said:

"The great purpose of chemical investigation in agriculture ought undoubtedly to be the discovery of improved methods of cultivation; and industry is never so efficacious as when assisted by science.

"Discoveries made in the cultivation of the earth, are not merely for the time and country in which they are developed, but they may be considered as extending to future ages, and as ultimately tending to benefit the whole human race; as affording subsistence for generations yet to come, as multiplying life, and not only multiplying life, but likewise providing for its enjoyment."

Great advances in agricultural research, to which Sir Humphry Davy gave such impetus, have since been made. Not the least of these is the increased knowledge of the value of nitrogen as a fertilizer. The widespread use of nitrogen is largely responsible for the high yields obtained in present-day agriculture.

IMPERIAL CHEMICAL INDUSTRIES LIMITED, LONDON, S.W.1

ICI

Please mention AGRICULTURE *when corresponding with Advertisers*

In
the

ay be
nd as
uman
ations
t only
for its

Davy
s the
The
ields

ICI

-1-9 56